

# Climate and Your Community

February 23, 2023

**Doug Kluck**

Central Region Climate Services Director  
NOAA National Center for Environmental Information

**Adele Phillips, CFM**

Flood Mitigation Planner  
Nebraska Department of Natural Resources



# *The Changing Climate, Extremes, Outlooks And Nebraska*

Doug Kluck  
Regional Climate Services Director  
NOAA's National Centers for Environmental Information

[Doug.kluck@noaa.gov](mailto:Doug.kluck@noaa.gov)

816-564-2417

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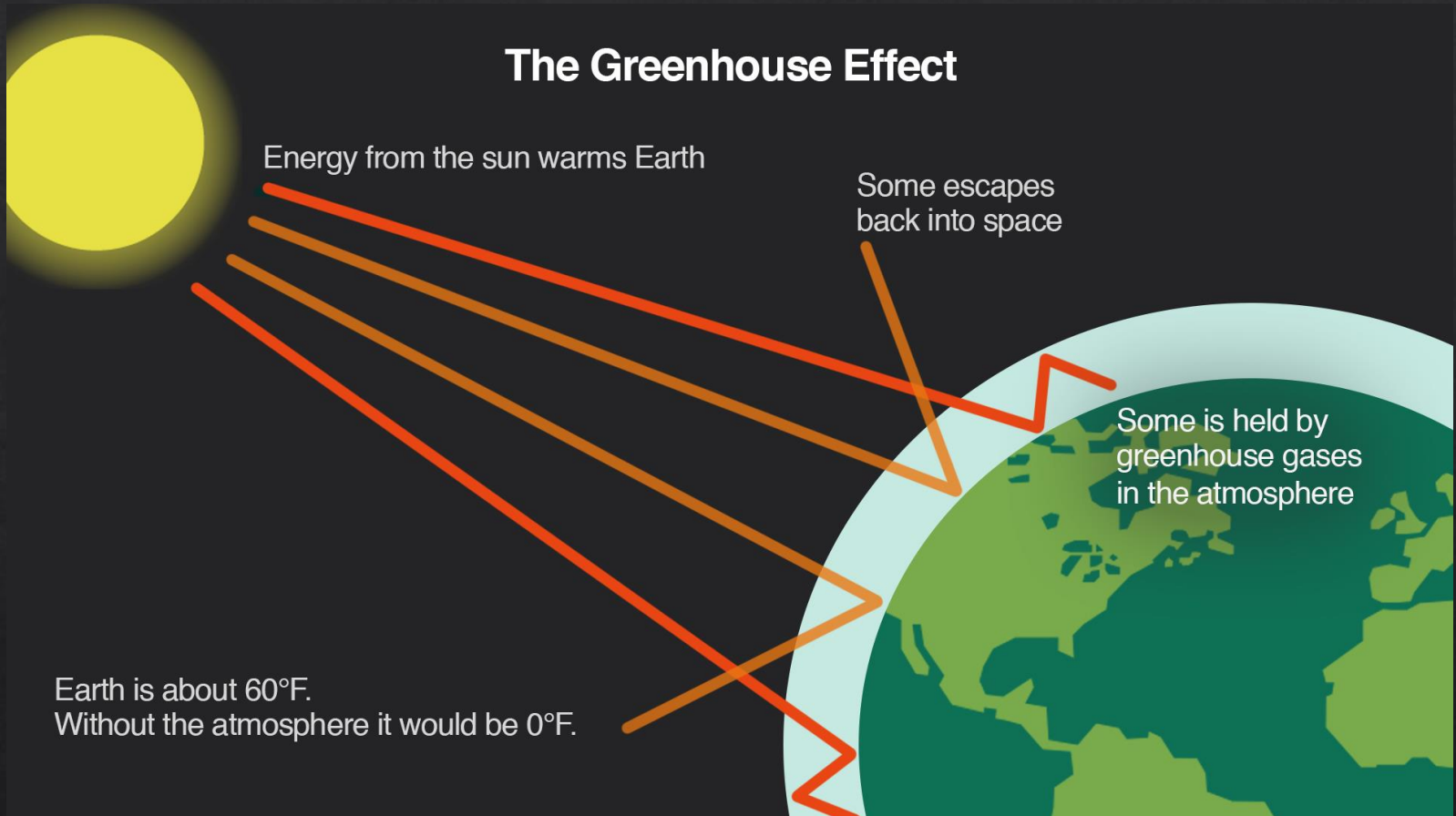


# Agenda

- Changing Climate
- Extremes
- Impacts
- Trends/Current
- Outlooks



# Science: Greenhouse Effect



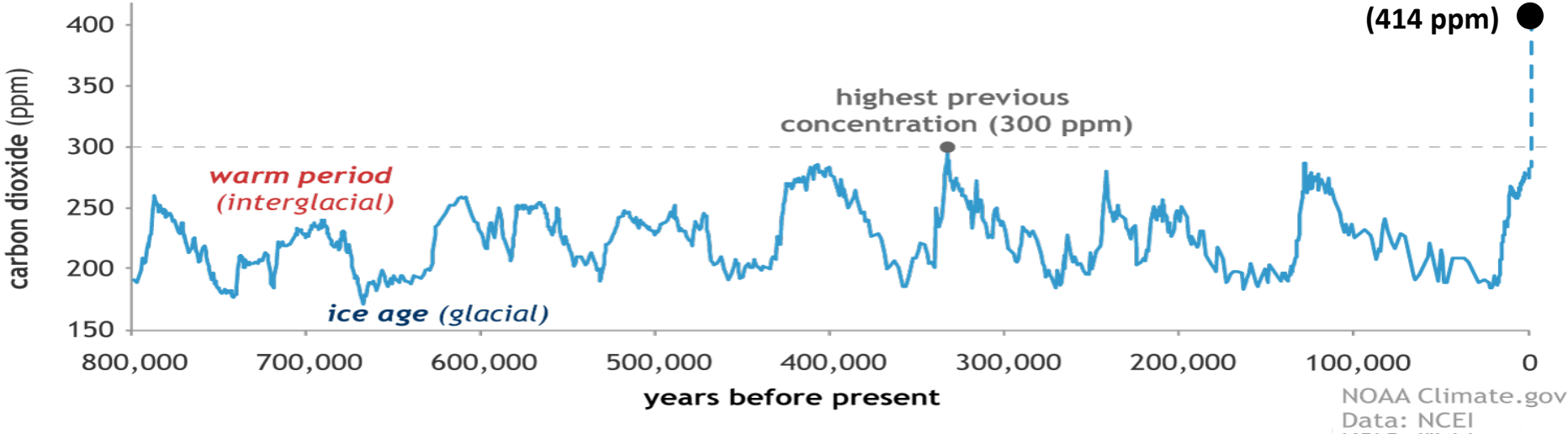
# We are outside the historical range and could move WAY outside that range this century.

2100 Higher Emission Scenario (900 ppm) ●

2100 Lower Emission Scenario (550 ppm) ●

2020 average (414 ppm) ●

CO<sub>2</sub> during ice ages and warm periods for the past 800,000 years



# The Ten Warmest Years Globally (1880–2022)

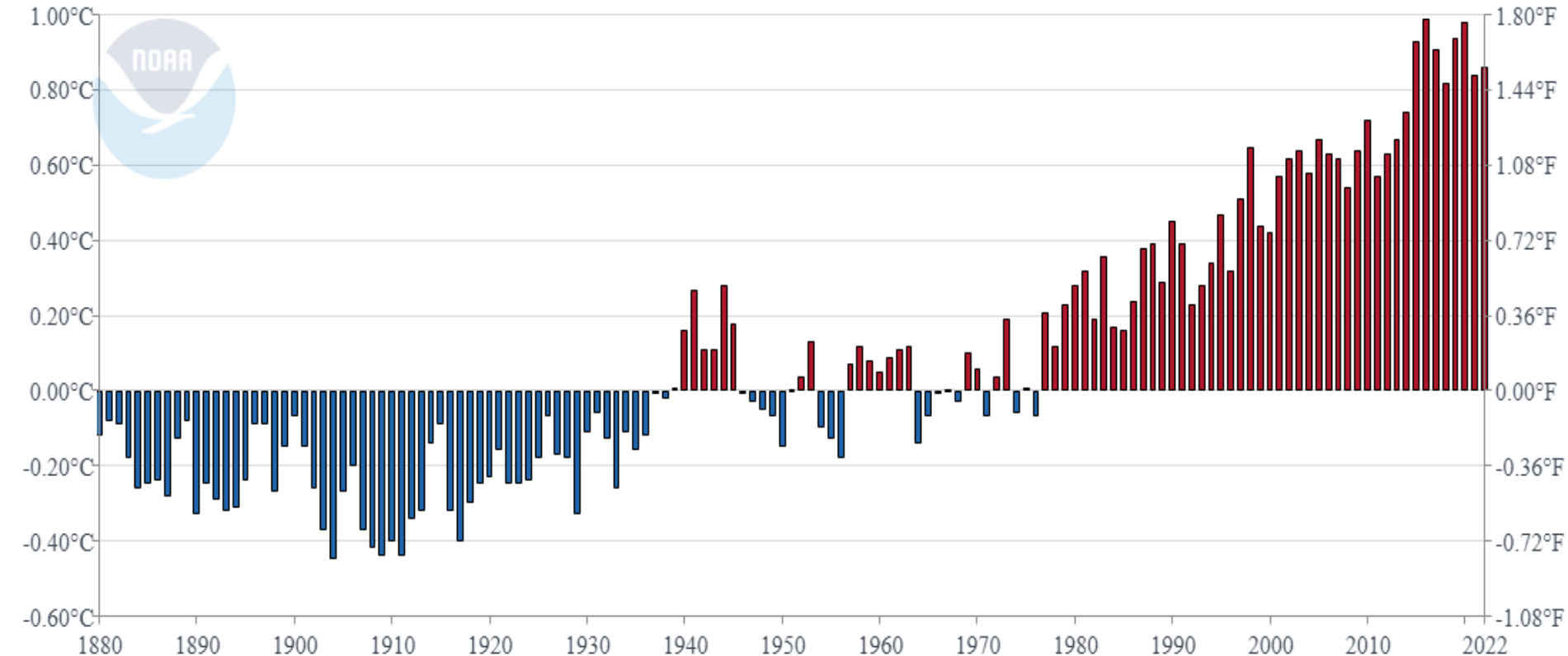
Rank 1 = Warmest Period of Record: 1880–2022	Year	Anomaly °C	Anomaly °F
1	2016	0.99	1.78
2	2020	0.98	1.76
3	2019	0.94	1.69
4	2015	0.93	1.67
5	2017	0.91	1.64
6	2022	0.86	1.55
7	2021	0.84	1.51
8	2018	0.82	1.48
9	2014	0.74	1.33
10	2010	0.72	1.30



# Global Temperatures (1880 – 2022)

## Global Land and Ocean

January-December Temperature Anomalies



## How does the climate in 2022 rank?

**2022 was the 18<sup>th</sup> warmest year on record for the U.S.**

**2022 was the 6<sup>th</sup> warmest year on record for the globe**

**2010-2022 top 10 warmest years globally since 1880**

**2022 global ocean heat content 6<sup>th</sup> highest on record**

**2015-2022 eight highest ocean heat content years**





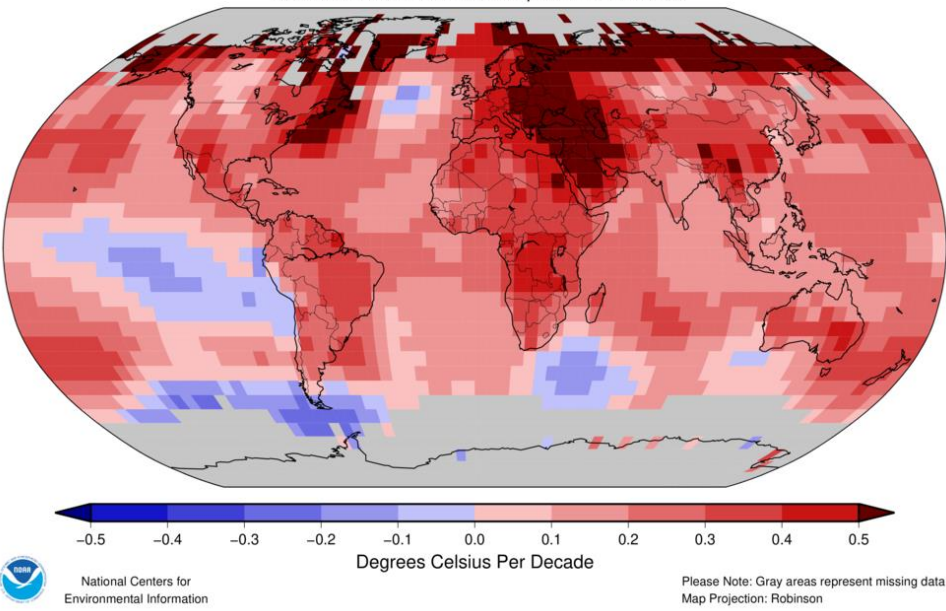
# Annual Trends through 2020

Increase in rate of warming over the past three decades in most areas

## Jan–Dec Land & Ocean Temperature Trends

Period: 1991–2020

Data Source: NOAA GlobalTemp v5.0.0–20210106

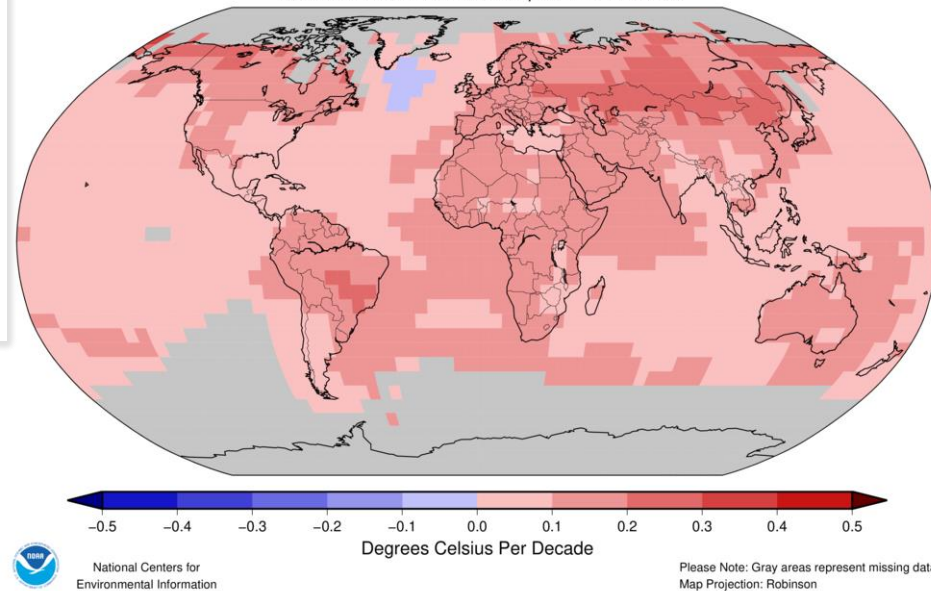


Last 120 years

## Jan–Dec Land & Ocean Temperature Trends

Period: 1901–2020

Data Source: NOAA GlobalTemp v5.0.0–20210106

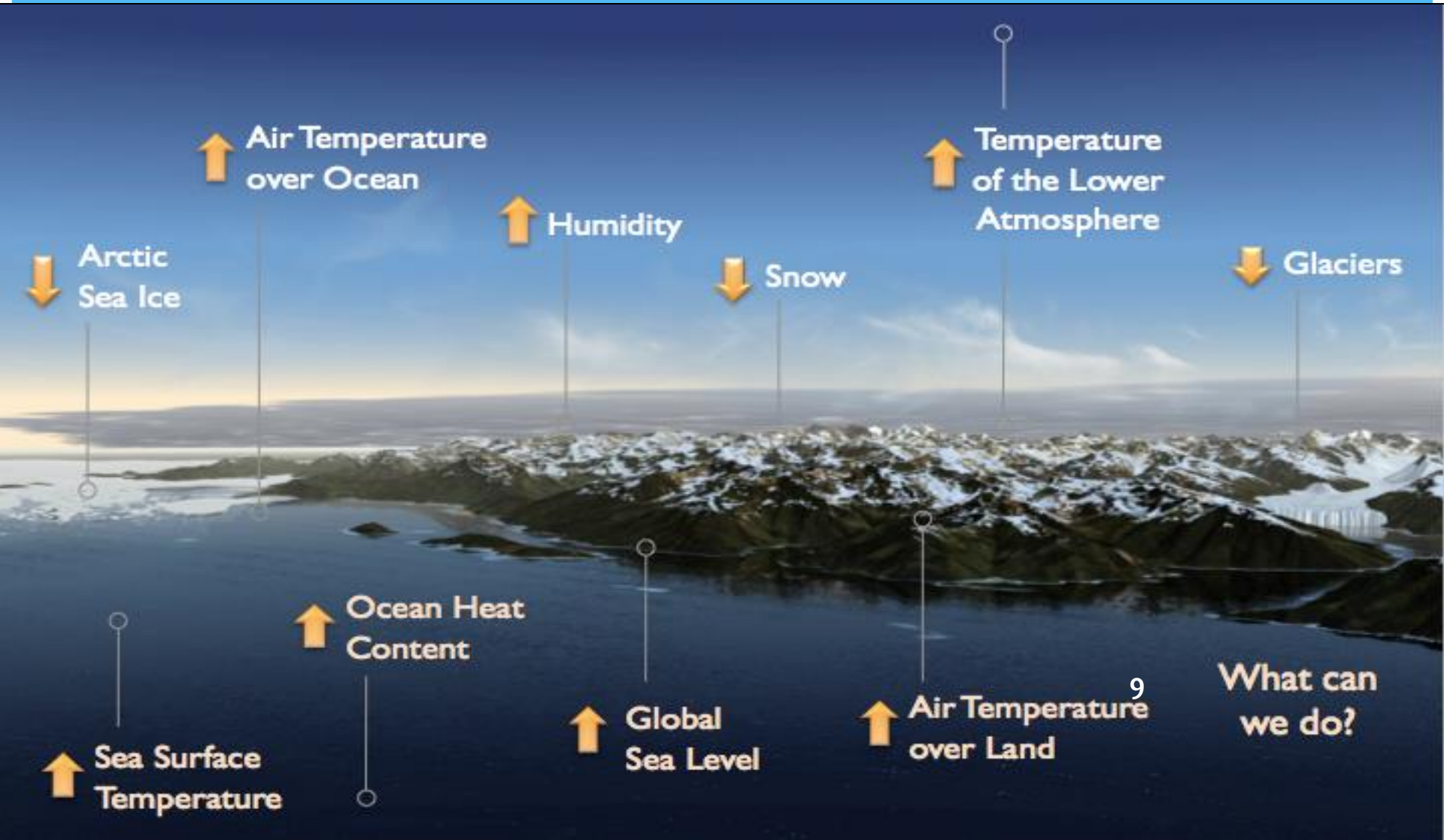


Last 30 years

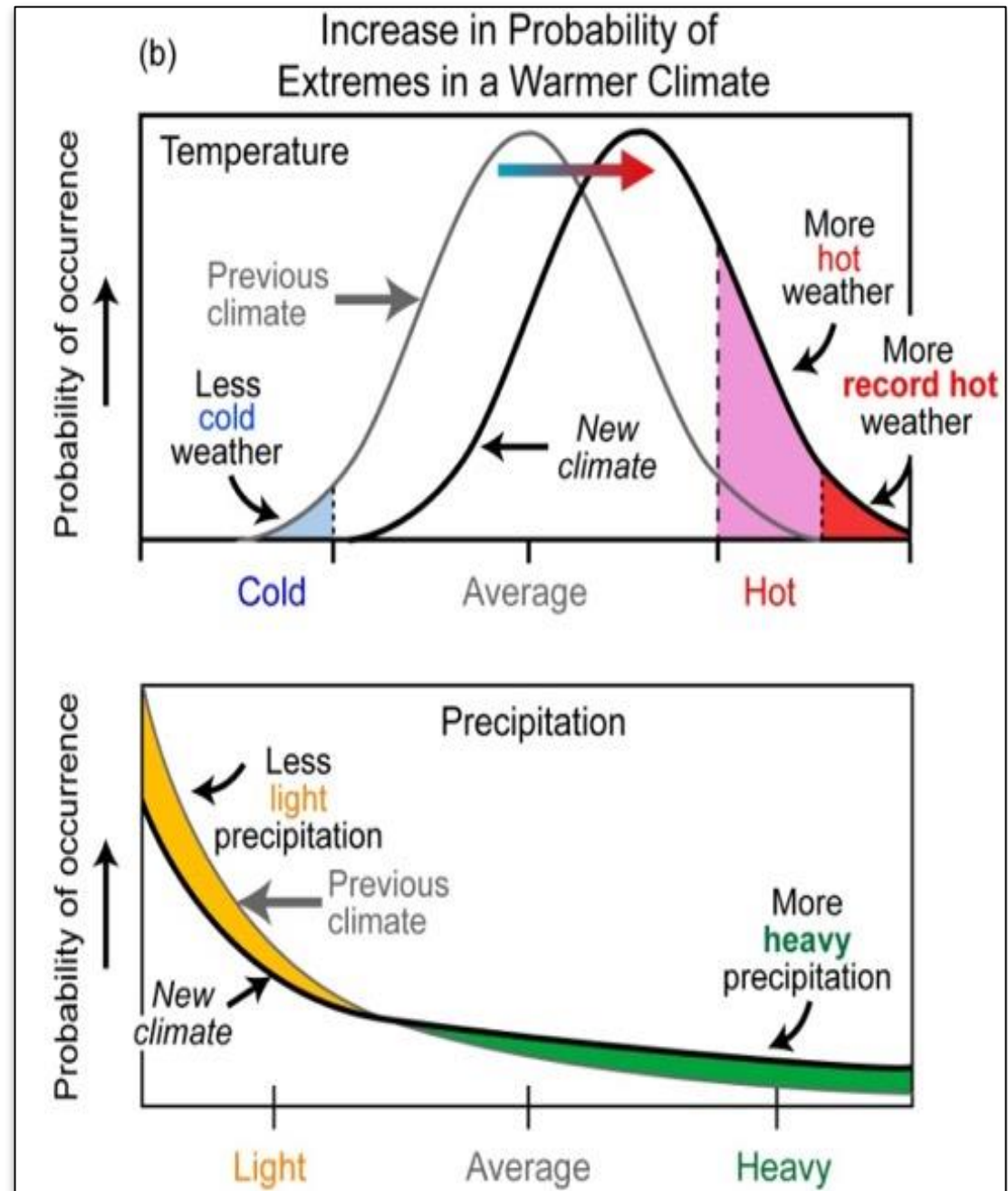


A CHANGING PLANET  
MEANS CHANGING  
CONDITIONS

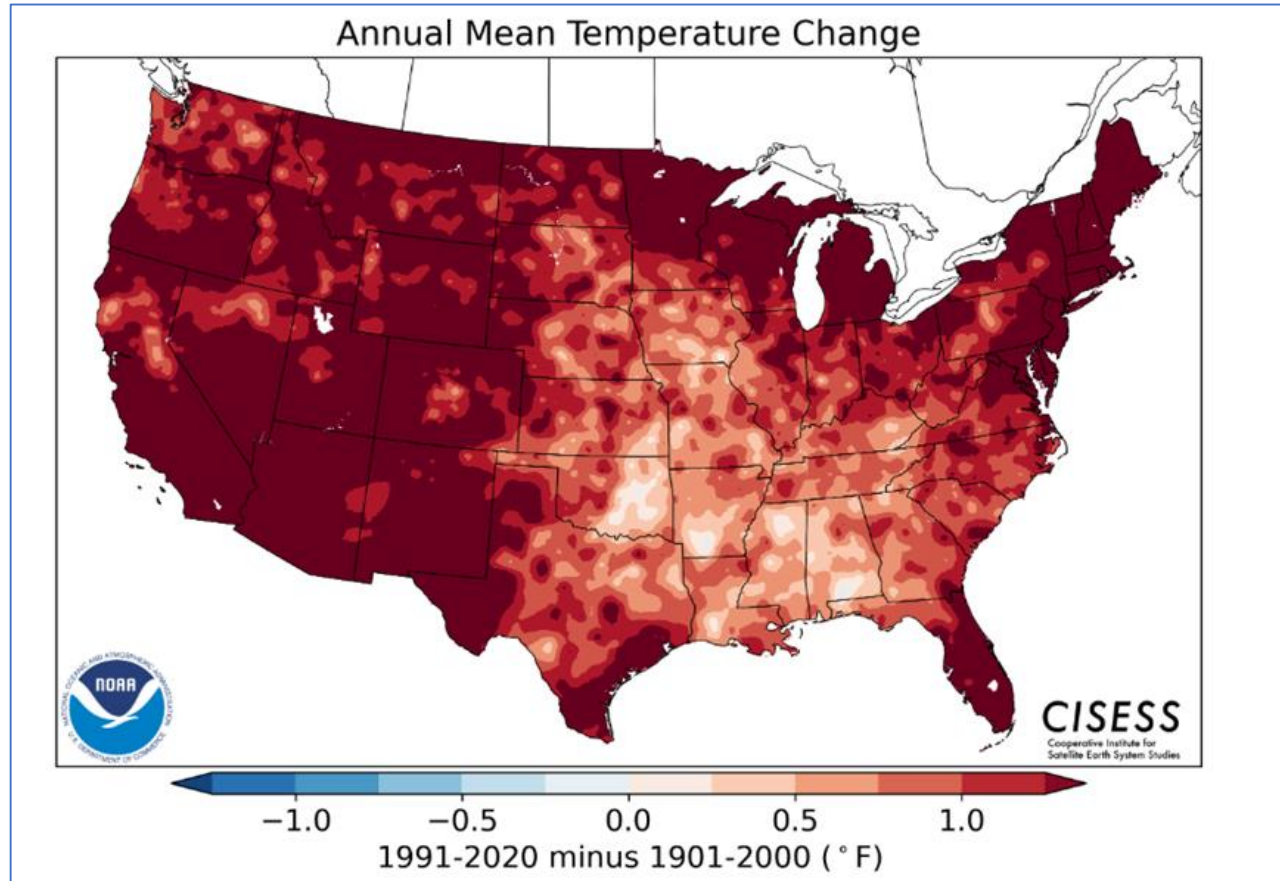
# Changing Climate Conditions Contribute to Extremes



Climate scientists predicted an increase in the probability of extreme events occurring due to global warming...



# Comparing 1991-2020 to 1901-2000: U.S.



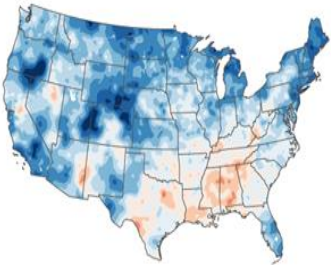
- Climate change is clearly seen in comparing the new normals to the Twentieth Century averages



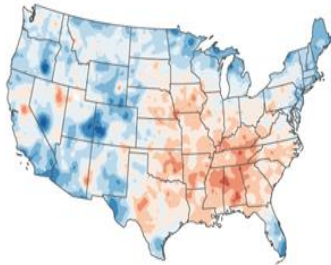
# Annual Temperature Normals since 1901 Compared to the 20<sup>th</sup> Century Average

## U.S. ANNUAL TEMPERATURE COMPARED TO 20<sup>th</sup>-CENTURY AVERAGE

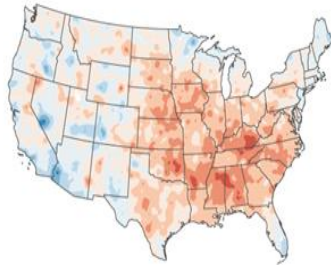
1901-1930



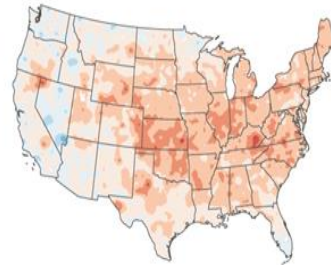
1911-1940



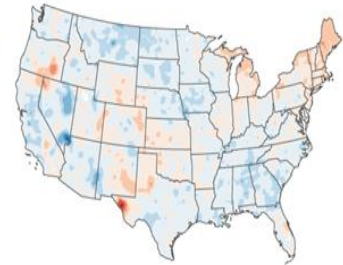
1921-1950



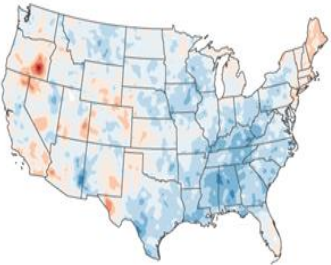
1931-1960



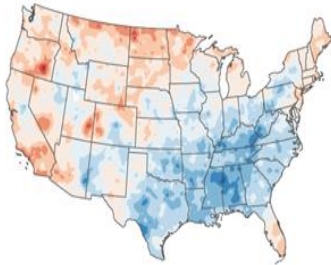
1941-1970



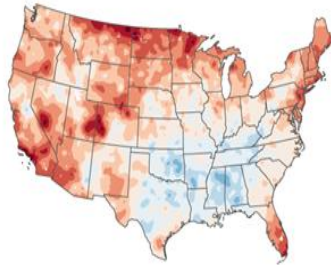
1951-1980



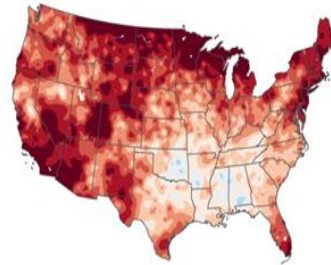
1961-1990



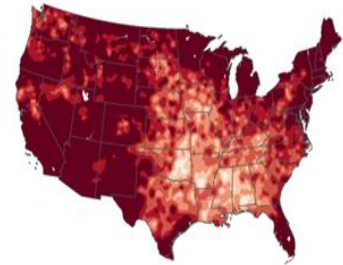
1971-2000



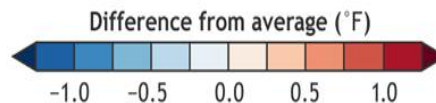
1981-2010



1991-2020



30-year Normal  
compared to 1901-2000

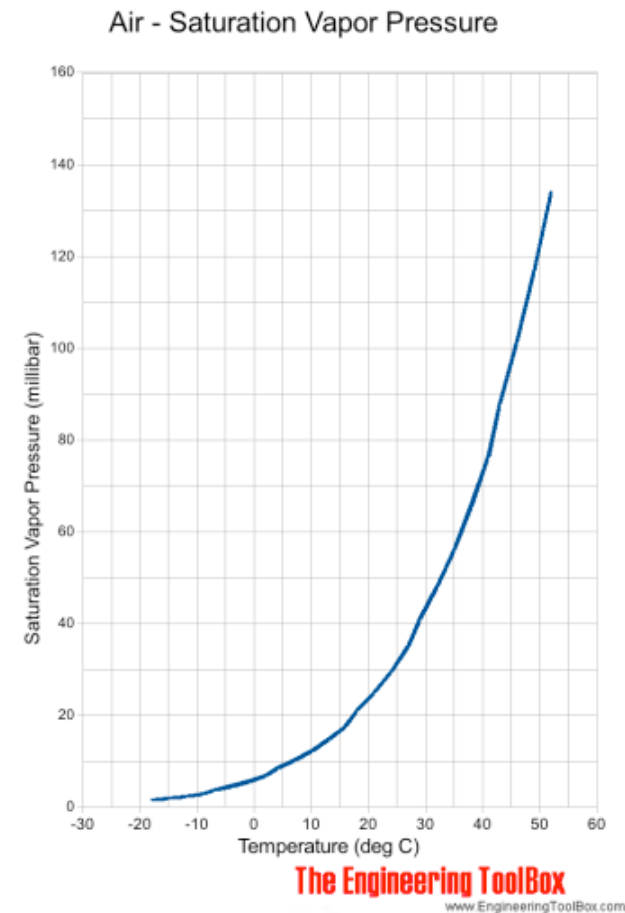


NOAA Climate.gov  
Data: NCEI

<https://www.climate.gov/news-features/understanding-climate/climate-change-and-1991-2020-us-climate-normals>

# Warm Air Holds More Water Vapor: A lot more

- Saturation vapor pressure is the total amount of pressure exerted if the air were saturated (relative humidity 100%)
  - Nearly doubles for every 10 deg C increase in temperature
  - Warm tropical air can hold 4-10 times as much vapor as cold, dry air
  - Consequently more latent heat release in storms, more precipitation



# Recent 30 years (1991-2020) compared to the past (1901-2000)

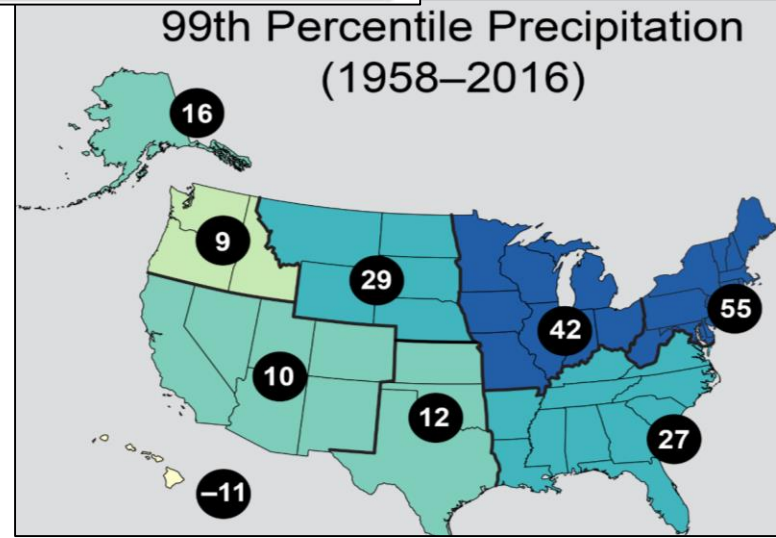
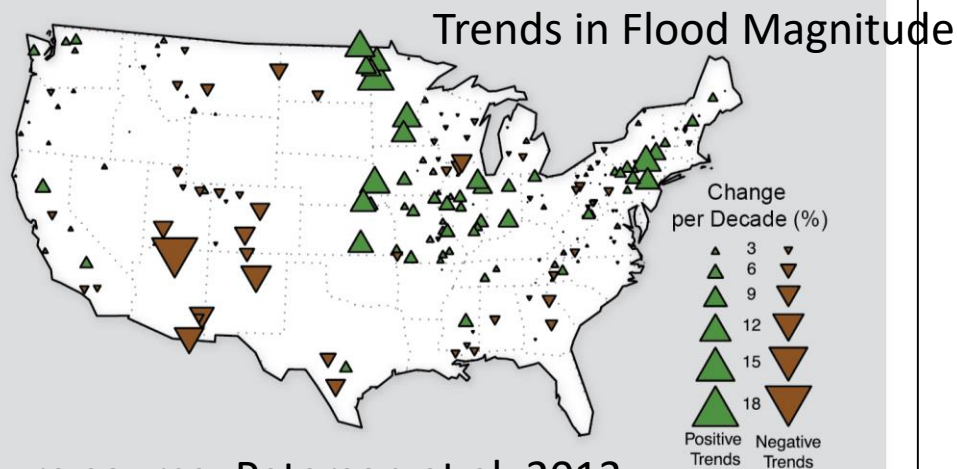
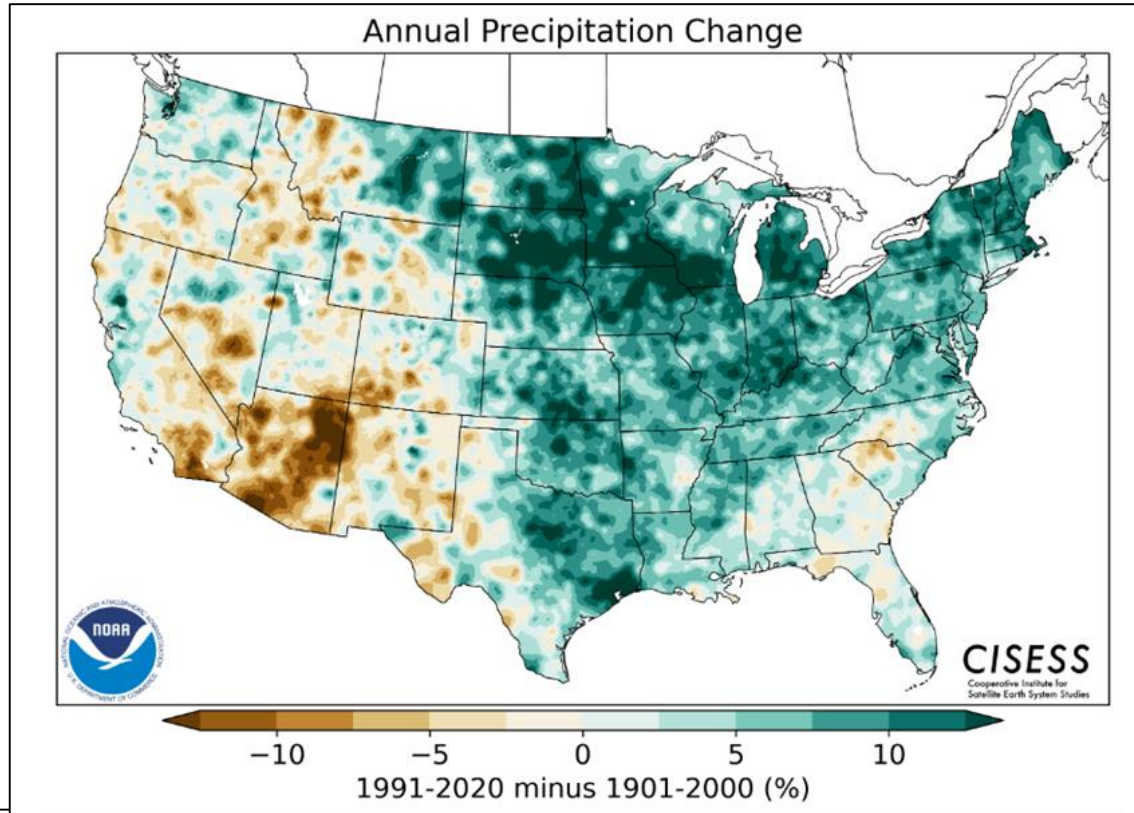
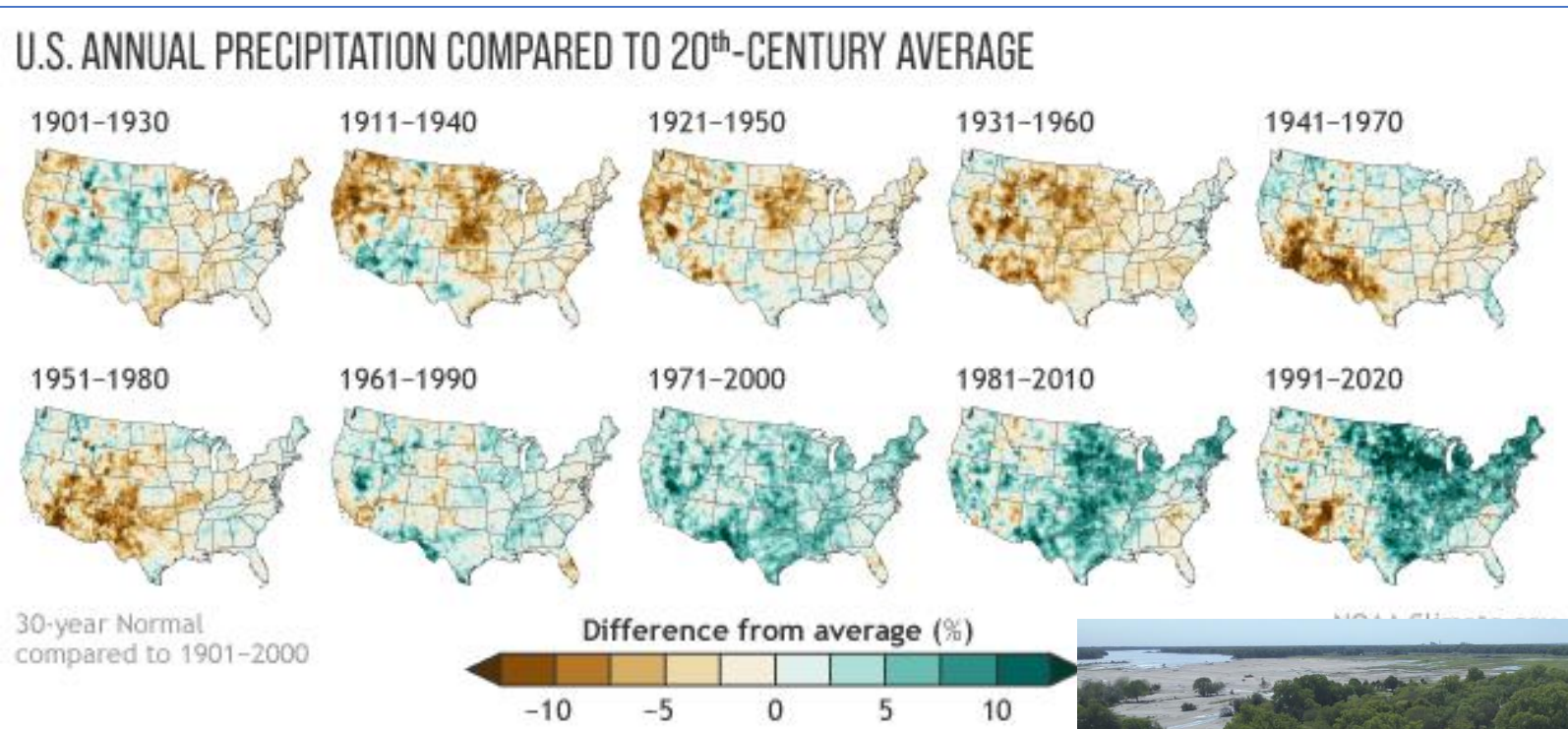


Figure source: Peterson et al. 2013

# Precipitation Changes Over the Decades (1901 -2020)

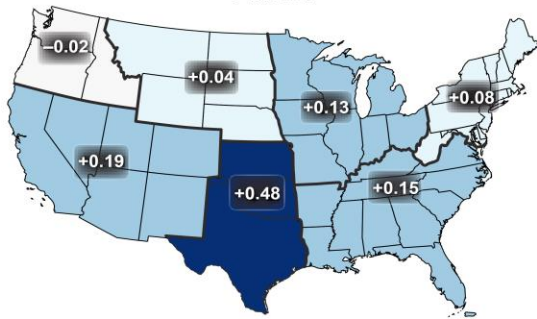




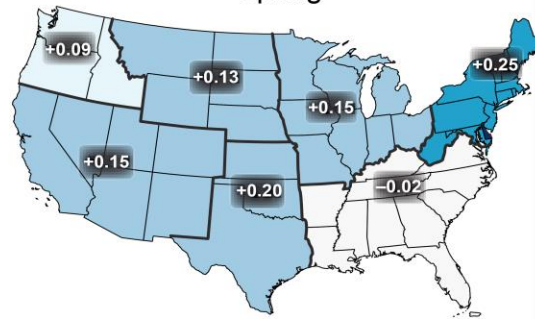
# Heavy Rainfall

## Observed Change in Daily, 20-year Return Level Precipitation

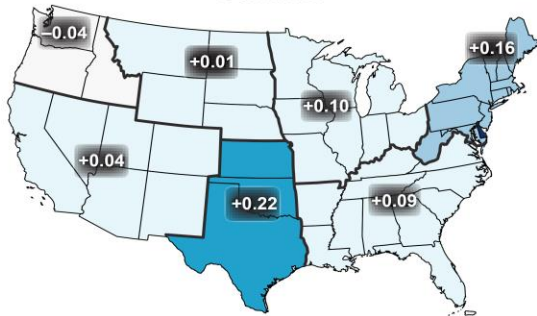
Winter



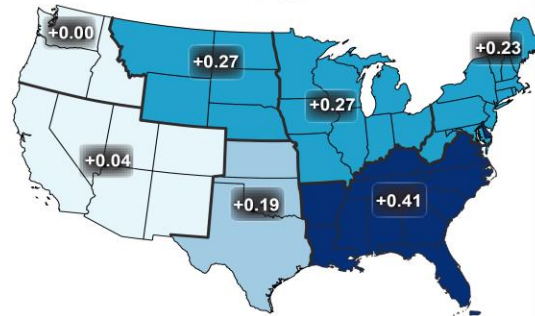
Spring



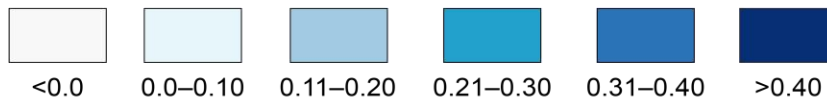
Summer



Fall



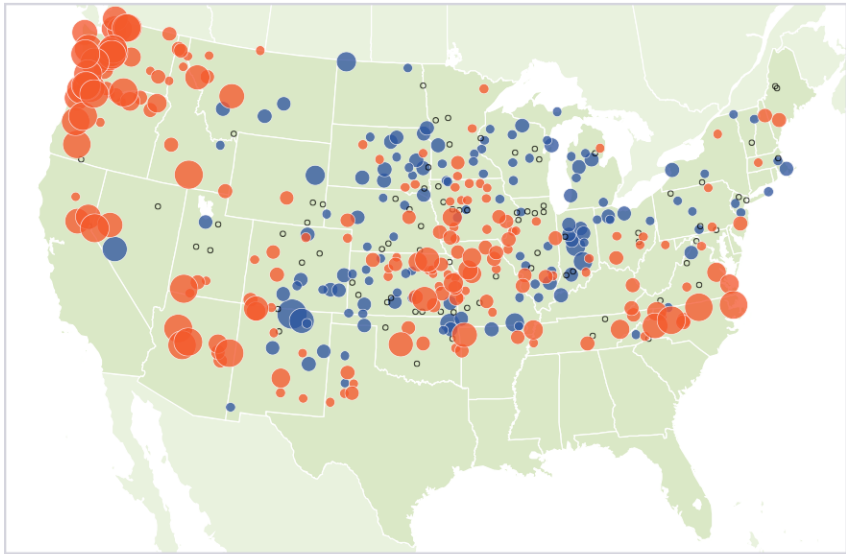
Change (inches)



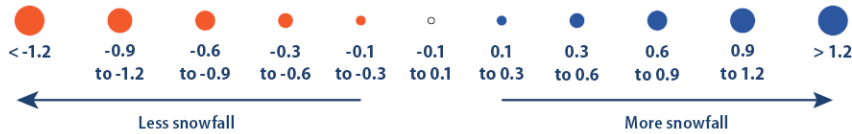
- Daily 20-year Return means amount of rainfall expected to occur, on average, once every 20 years
- Amounts have increased more than 0.4 inch in places (slight decrease in some places)
- Varies geographically by season

# Snowfall: Increases in total snowfall amounts in the Northern Plains but increases in the proportion of precipitation falling as rain

Change in Total Snowfall in the Contiguous 48 States, 1930–2007



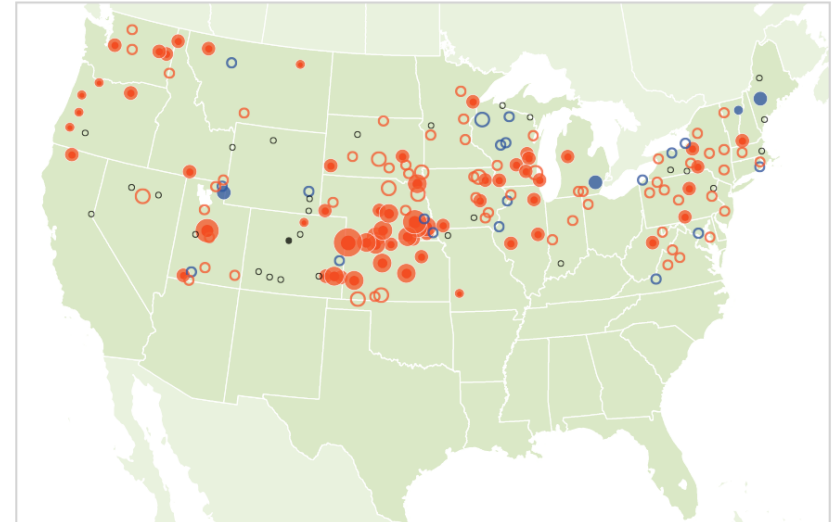
Rate of change (percent per year):



Data source: Kunkel, K.E., M. Palecki, L. Ensor, K.G. Hubbard, D. Robinson, K. Redmond, and D. Easterling. 2009. Trends in twentieth-century U.S. snowfall using a quality-controlled dataset. *J. Atmos. Ocean. Tech.* 26:33–44.

For more information, visit U.S. EPA's "Climate Change Indicators in the United States" at [www.epa.gov/climate-indicators](http://www.epa.gov/climate-indicators).

Change in Snow-to-Precipitation Ratio in the Contiguous 48 States, 1949–2020



Percent change:



Filled circles represent statistically significant trends.  
Open circles represent trends that are not statistically significant.

Data source: NOAA (National Oceanic and Atmospheric Administration). 2021. National Centers for Environmental Information. Accessed February 2021. [www.ncdc.noaa.gov](http://www.ncdc.noaa.gov).

For more information, visit U.S. EPA's "Climate Change Indicators in the United States" at [www.epa.gov/climate-indicators](http://www.epa.gov/climate-indicators).

# Extremes...



More frequent & more severe **extreme events**.  
Communities & businesses are feeling the **impacts**.



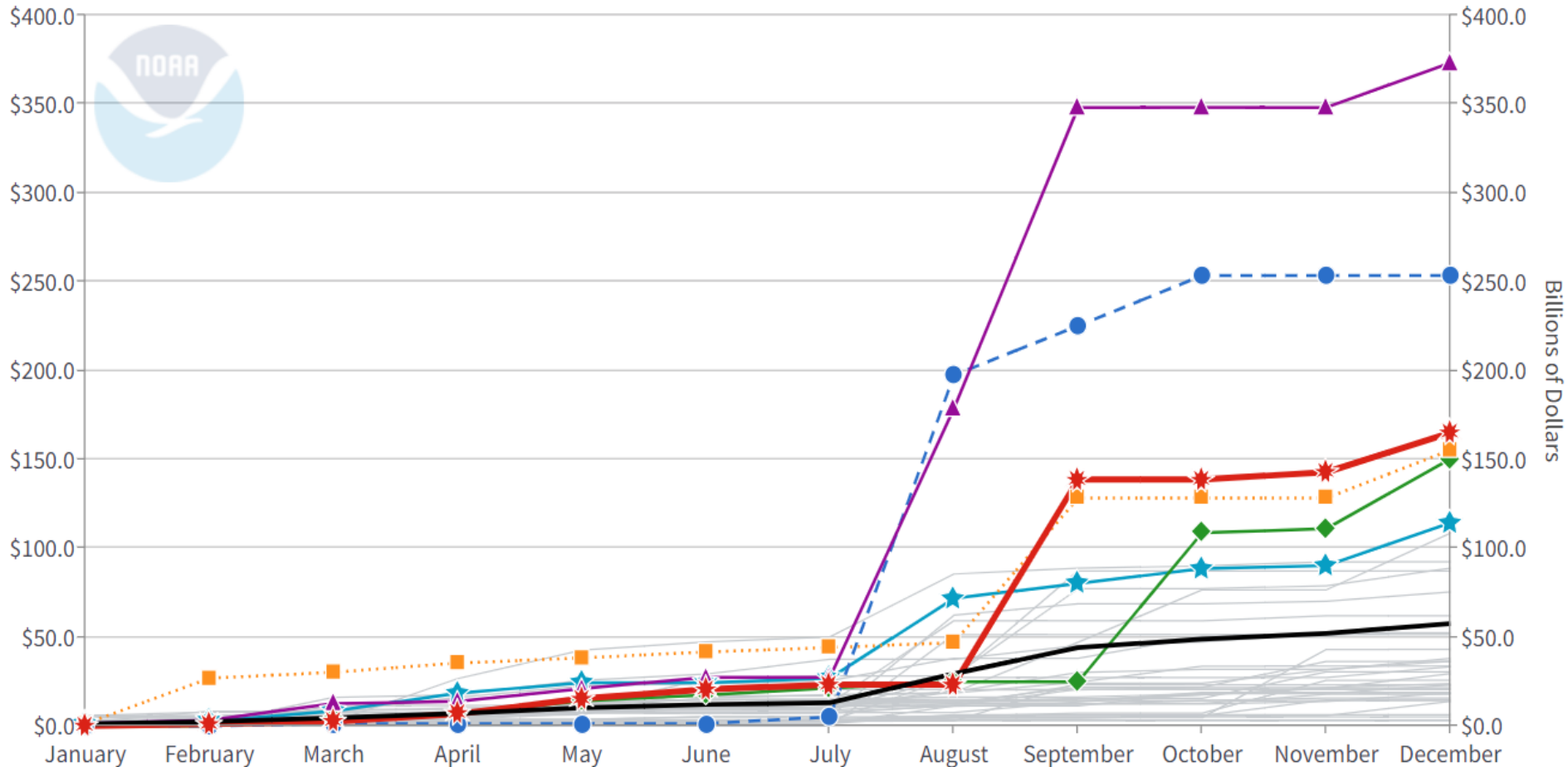
The total cost of these 341 events exceeds \$2.475 trillion

# U.S. Disaster Trends

1980-2022 United States Billion-Dollar Disaster Event Cost (CPI-Adjusted)

Close

★ 2020 (\$114.3B)    ◆ 2012 (\$150.3B)    ■ 2021 (\$155.3B)    ● 2005 (\$253.5B)    ▲ 2017 (\$373.2B)    ★ 2022 (\$165.0B)    — Average (\$57.6B)



ated: January 10, 2023

Event statistics are added according to the date on which they ended.

# U.S. billion-dollar disasters since 1980— both number & costs have **quadrupled**.\*

\*Adjusted for inflation



**\$18 billion**

1980s



**\$28 billion**

1990s



**\$54 billion**

2000s



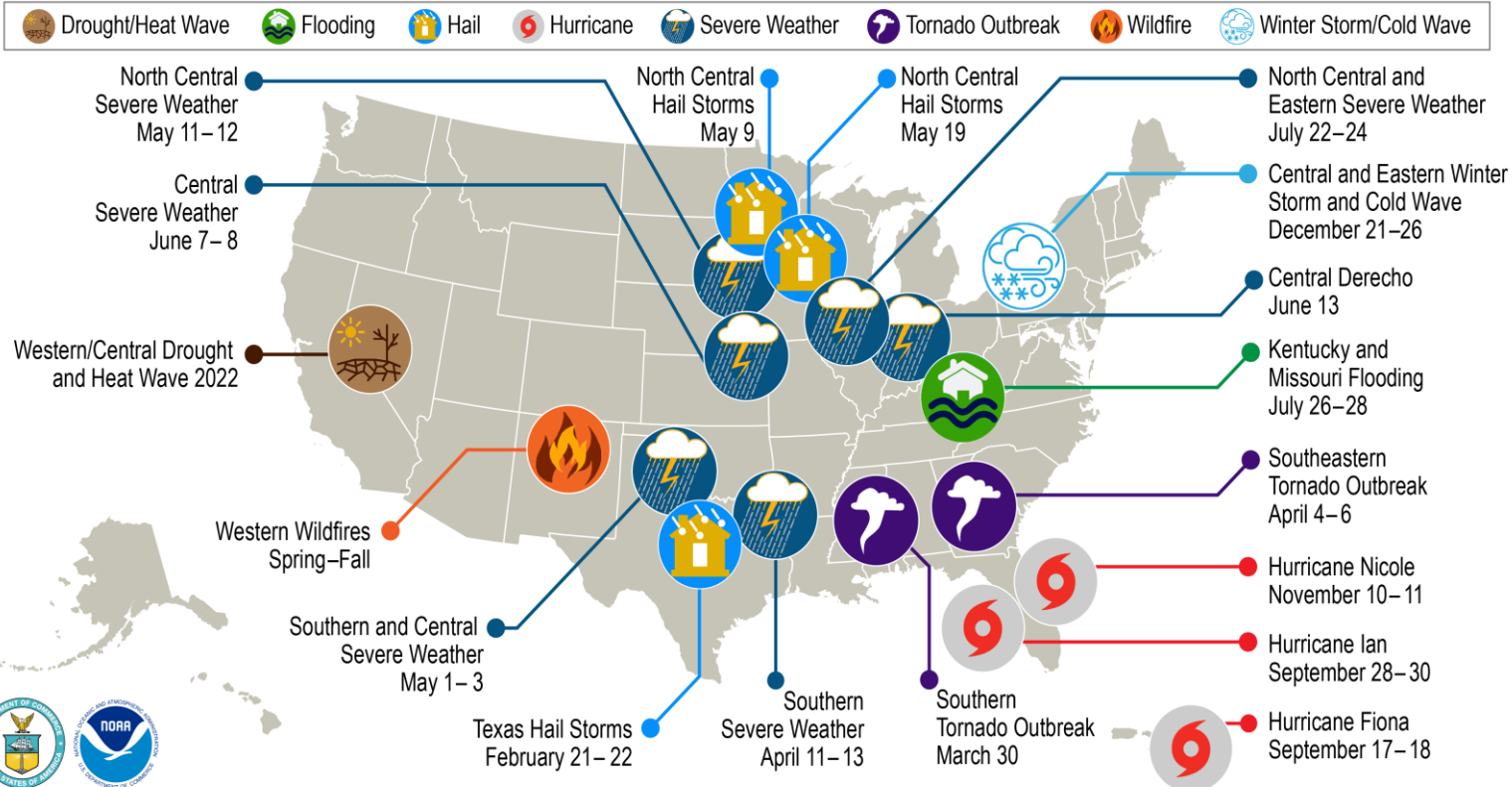
**\$85 billion**

2010s

Source: NOAA NCEI

# 2022 Billion \$ Disasters

## U.S. 2022 Billion-Dollar Weather and Climate Disasters



This map denotes the approximate location for each of the 18 separate billion-dollar weather and climate disasters that impacted the United States in 2022.

**2022**  
**474 deaths**  
**18 events**  
**\$165 billion**

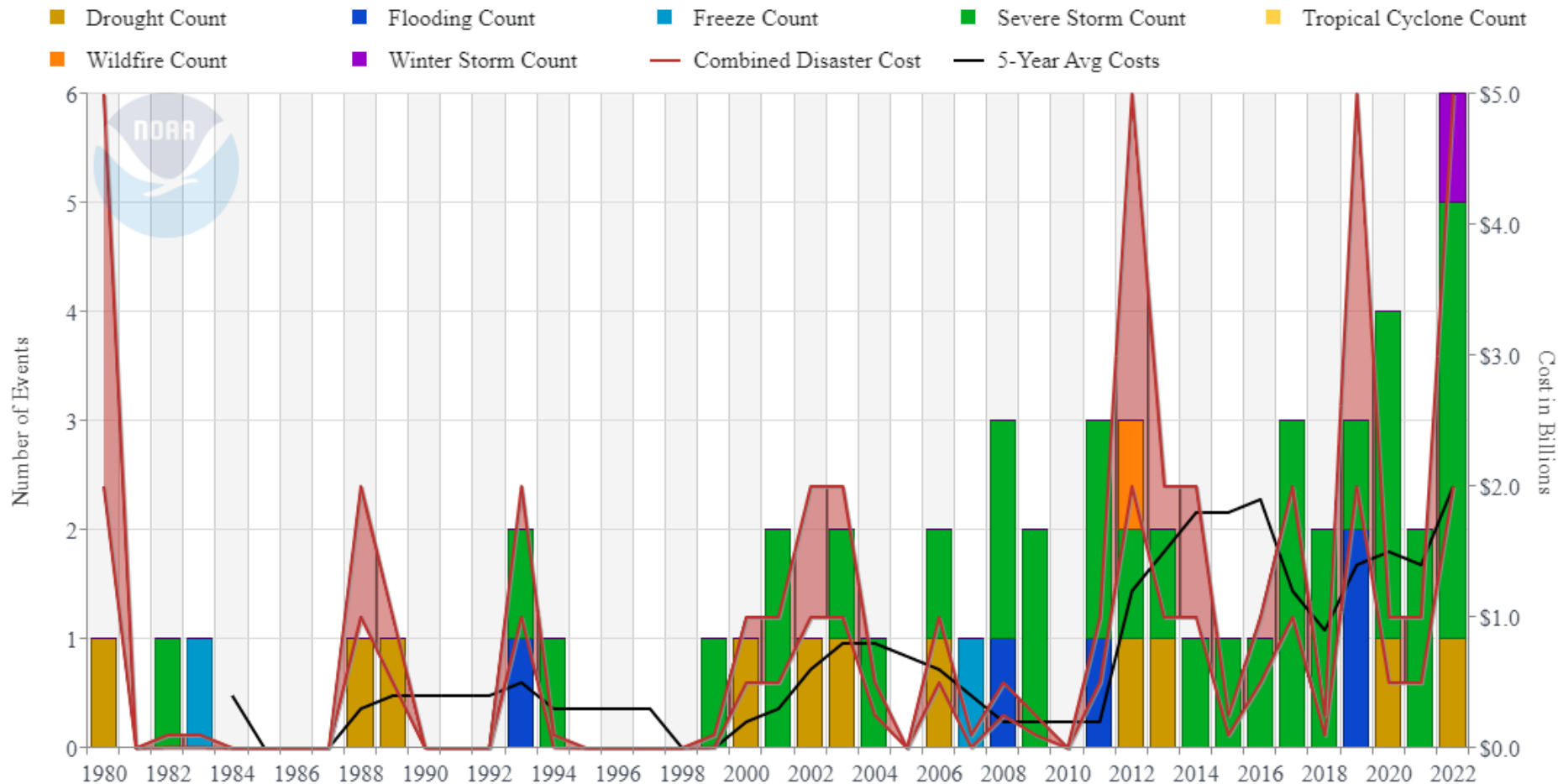
**1+ trillion last  
 7 years**

<https://www.ncei.noaa.gov/access/billions/>

# NE Disaster Trends

<https://www.ncei.noaa.gov/access/billions/time-series/NE>

### Nebraska Billion-Dollar Disaster Events 1980-2022 (CPI-Adjusted)



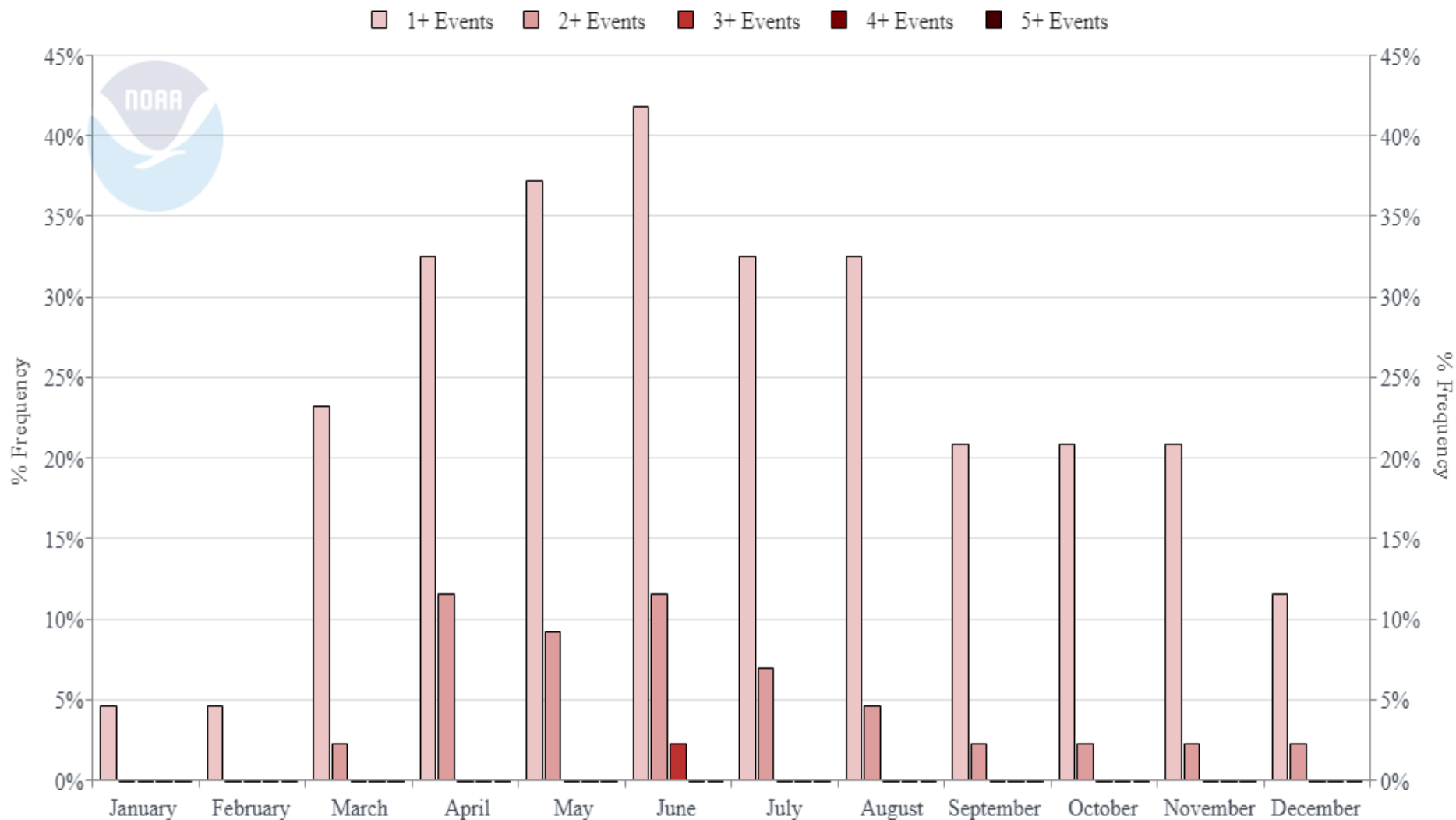
Updated: January 10, 2023





# Nebraska Disasters by Month









Nebraska Billion-Dollar Disaster Frequency 1980-2022 (CPI-Adjusted)



# Total Impacts By Disaster Type (NE)

<https://www.ncei.noaa.gov/access/billions/summary-stats>

*Billion-dollar events to affect Nebraska from 1980 to 2022 (CPI-Adjusted)*

Disaster Type	Events	Events/Year	Percent Frequency	Total Costs	Percent of Total Costs
 Drought	11	0.3	20.0%	\$10.0B-\$20.0B	46.4%
 Flooding	5	0.1	9.1%	\$2.0B-\$5.0B	15.0%
 Freeze	2	0.0	3.6%	\$5M-\$100M	0.2%
 Severe Storm	35	0.8	63.6%	\$10.0B-\$20.0B	38.2%
 Tropical Cyclone	--	--	--	--	--
 Wildfire	1	0.0	1.8%	\$5M-\$100M	0.2%
 Winter Storm	1	0.0	1.8%	\$0M-\$0M <sup>†</sup>	0.0% <sup>†</sup>
 All Disasters	55	1.3	100.0%	\$20.0B-\$50.0B <sup>†</sup>	100.0% <sup>†</sup>

# Disaster Cost and Frequency

Map: Cost/Millior ▾

Begin Year: 1980 ▾

End Year: 2022 ▾

Event: All Events

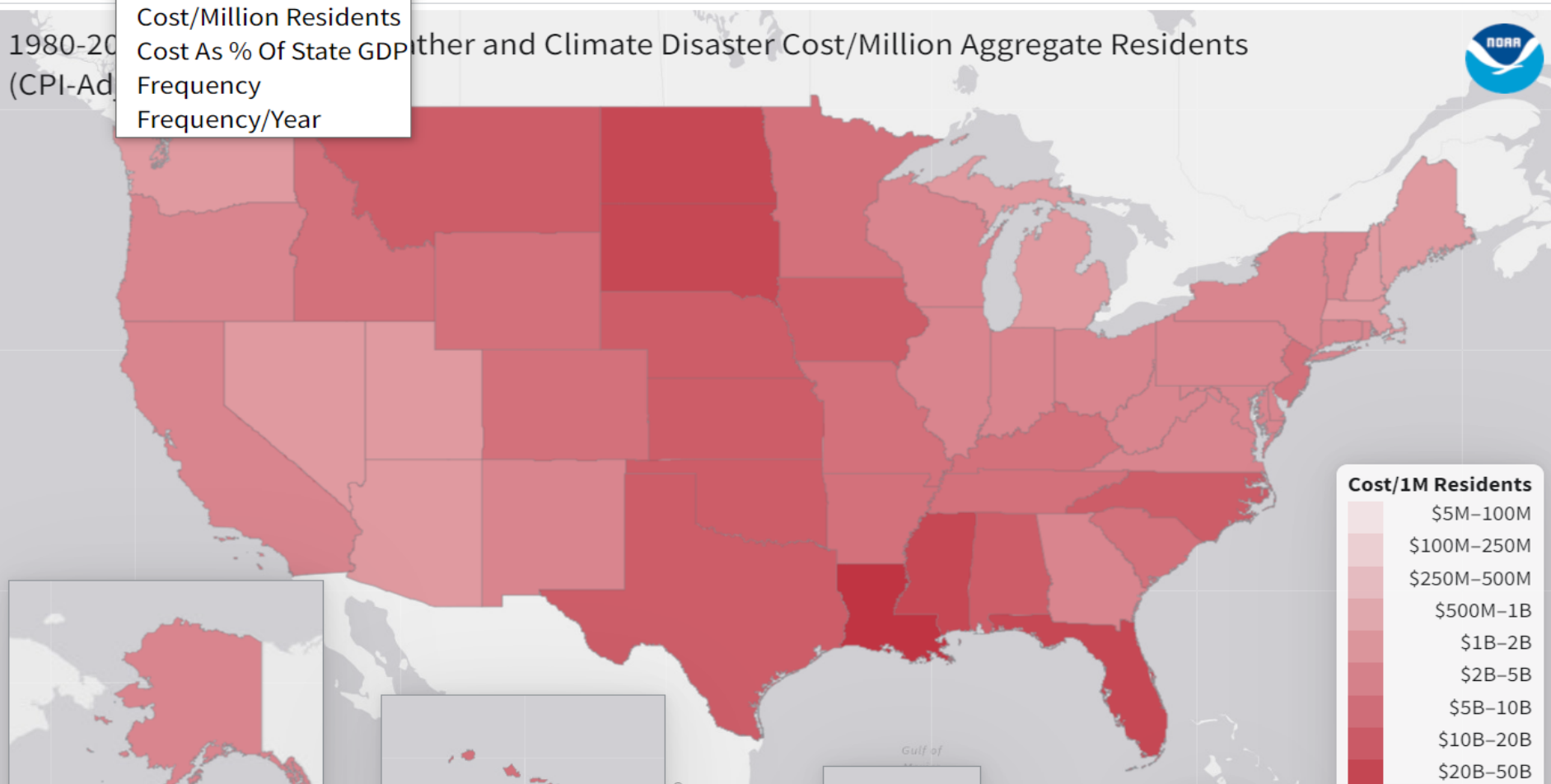


Update

CPI-Adjusted Unadjusted

- Cost
- Cost/Year
- Cost/Event
- Cost/Million Residents
- Cost As % Of State GDP
- Frequency
- Frequency/Year

1980-2022 (CPI-Adjusted) Other and Climate Disaster Cost/Million Aggregate Residents



### Cost/1M Residents

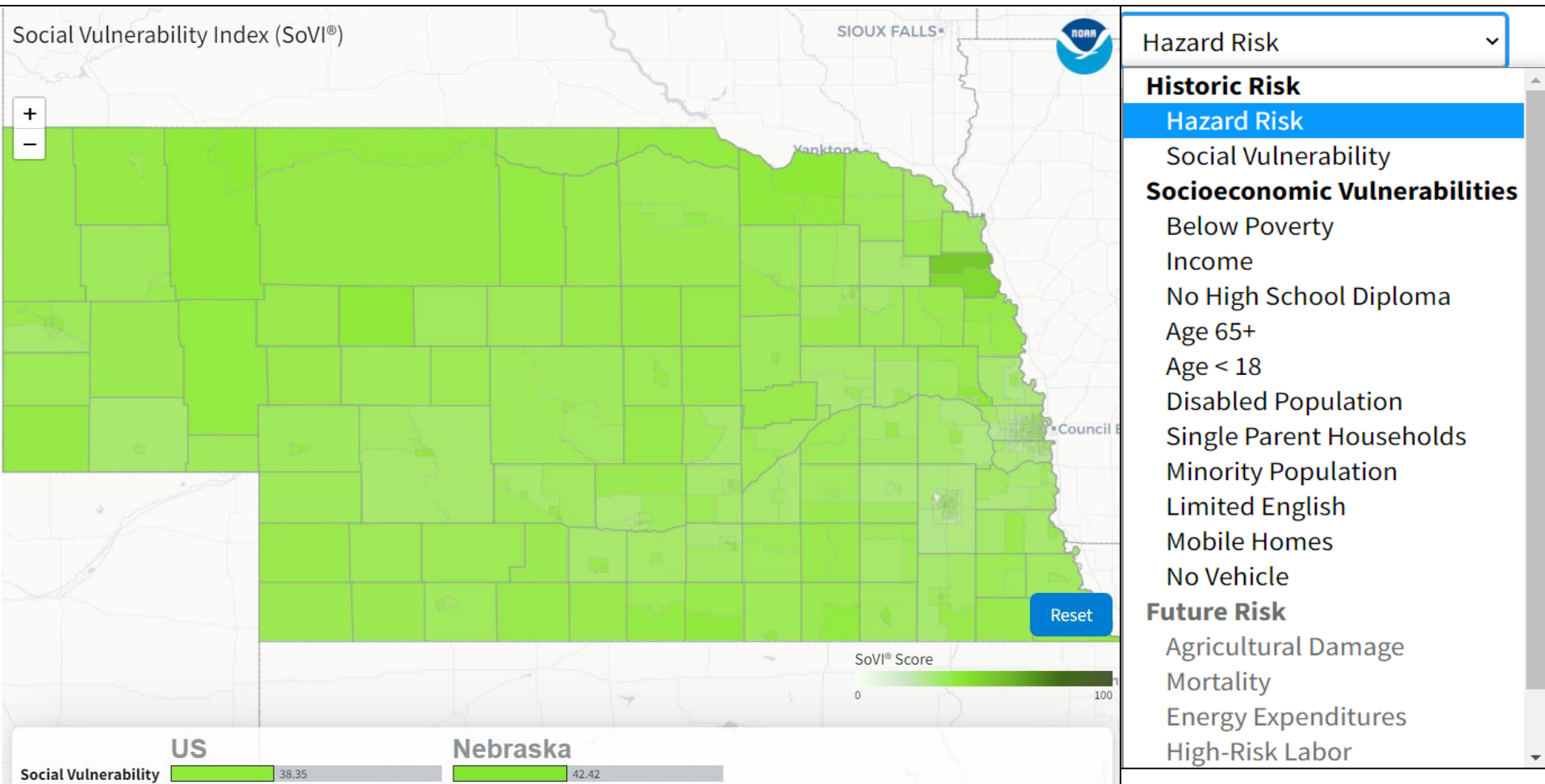
- \$5M-100M
- \$100M-250M
- \$250M-500M
- \$500M-1B
- \$1B-2B
- \$2B-5B
- \$5B-10B
- \$10B-20B
- \$20B-50B



# Interactive U.S. county hazard risk maps

- NCEI worked with & expanded upon FEMA's NRI (National Risk Index) team to enhance the NOAA Billion-dollar disaster website producing **127 new, interactive U.S. county hazard risk maps** for any combination of county-level hazard risk for: hurricanes, severe storms (tornado, hail, damaging winds), inland/urban flooding, drought/heat wave, wildfire, winter storms and freeze/cold wave events.
- Importantly, these maps offer more granular information in relation to **exposure, vulnerability and resilience** to weather & climate hazards, at a county scale.
- These new hazard combination maps are useful as we see more focus on **cascading hazard impacts**  
**For example:** drought-enhanced wildfires produce mountain-side burn scars, which often enhance debris flows from flooding. This is a compound hazard with cascading impacts that we see in California.

# NE Risk and Vulnerability



<https://www.ncei.noaa.gov/access/billions/mapping>



# Risk and Vulnerability by County/Tract (Harlan County)

Socioeconomic Vulnerabilities	Census Tract 9642	Harlan County	Nebraska	U.S.
Below Poverty (% of Population)	11.20%	11.20%	--	--
Income (Per Capita Income)	\$27,421.00	\$27,421.00	\$--	\$--
No High School Diploma (% of Population)	9.90%	9.90%	--	--
Age 65+ (% of Population)	25.00%	25.00%	--	--
Age < 18 (% of Population)	22.50%	22.50%	--	--
Disabled Population (% of Population)	16.30%	16.30%	--	--
Single Parent Households (% of Population)	3.90%	3.90%	--	--
Minority Population (% of Population)	6.10%	6.10%	--	--
Limited English (% of Population)	0.40%	0.40%	--	--
Mobile Homes (% of Homes)	22.90%	22.90%	--	--
No Vehicle (% of Households)	1.80%	1.80%	--	--
Energy Expenditures (% Change)	--	10.24%	9.01%	9.24%
High-Risk Labor (% Change)	--	-1.50%	-1.58%	-1.51%
Coastal Storm Damage (% County GDP)	--	--	--	0.29%
Total Damage (% County GDP)	--	2.54%	2.06%	4.57%



# Impacts



# Current and Potential Impacts

- **Health (smoke, heat, allergies, invasive diseases)**
- **Water (quantity, quality)**
- **Drought/Flood (flash, urban/rural issues, energy production)**
- **Cascading issues (e.g. migration, supply chains)**
- **Infrastructure (transportation, utilities etc..)**
- **Rural (Ag. implications, heat health)**
- **Ecosystems (loss of habitat, restorative ability, balance)**
- **Equity: Vulnerable populations especially vulnerable to small “disasters” or series of events**
  - **Place based vulnerabilities (flood plain, etc...)**



# Record-Setting Wildfire Season

Over 10 million acres burned, California and Colorado were scorched



Data courtesy of National In...



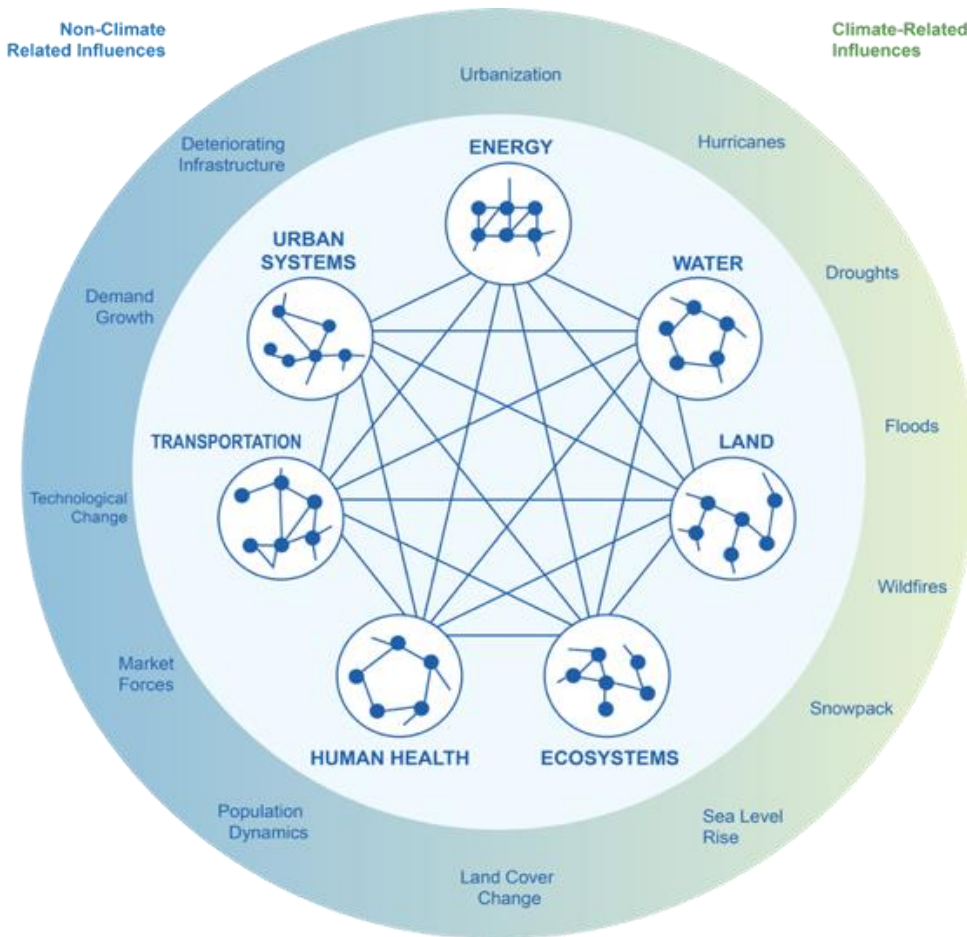
\* Does not include North Carolina in 2004



National Centers for Environmental Information



# Extreme events tend to cause multi-stressor situations



Sectors are interacting & interdependent through physical, social, institutional, environmental, and economic linkages.

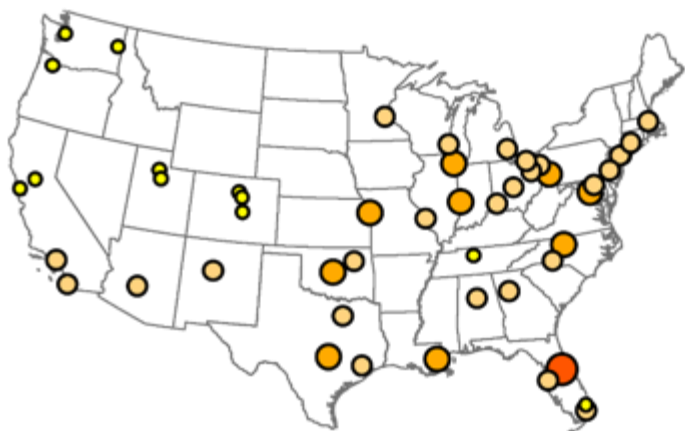
These sectors and the interactions among them are affected by a range of climate-related and non-climate influences.

## Example

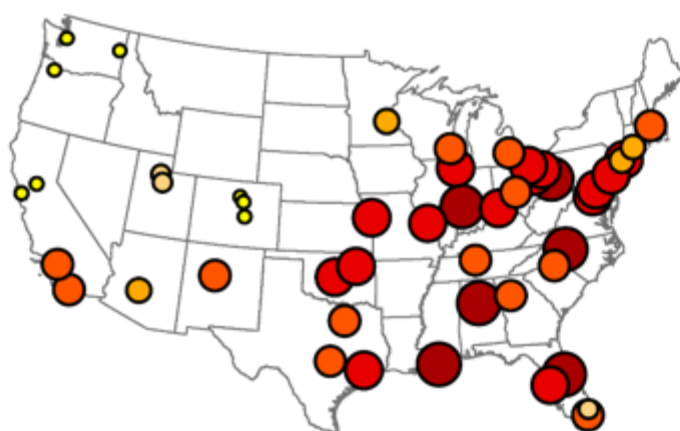
1. Wildfire chars California hillside
2. Atmospheric river dumps heavy rain
3. Rainfall causes a landslide
4. Landslide cuts off roadways
5. Services and economic activity are disrupted

# Increases in heat-related deaths are projected To outweigh reductions in cold-related deaths.

Lower Scenario  
(RCP4.5)



Higher Scenario  
(RCP8.5)



Change in Mortality Rate  
(deaths per 100,000 people)

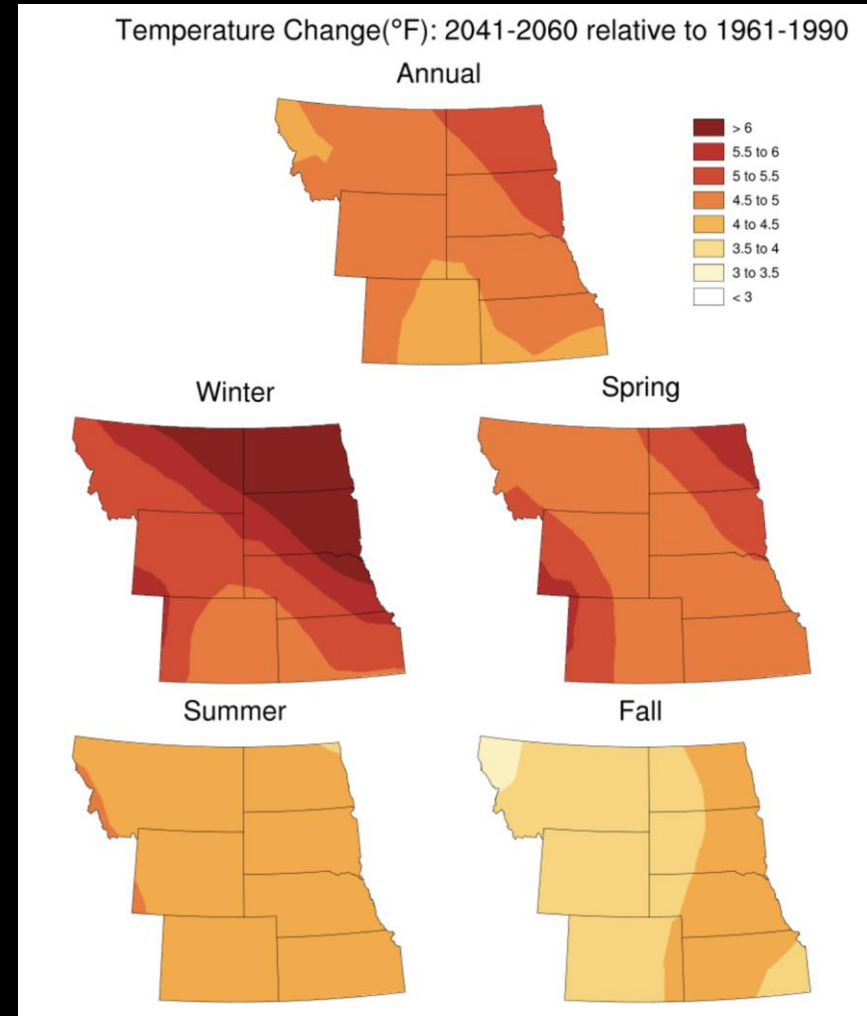


Source: NCA4

# Temperature Projections

## Projected Temperature Change by 2050

- ❖ Annual temperatures are expected to increase by 5-6°F
- ❖ Winter and Spring to experience the largest increases
- ❖ The frequency and intensity of heat spells are projected to increase throughout the 21st century while those for cold spells are projected to decrease
- ❖ Risk of frost damage to vegetation may not change substantially

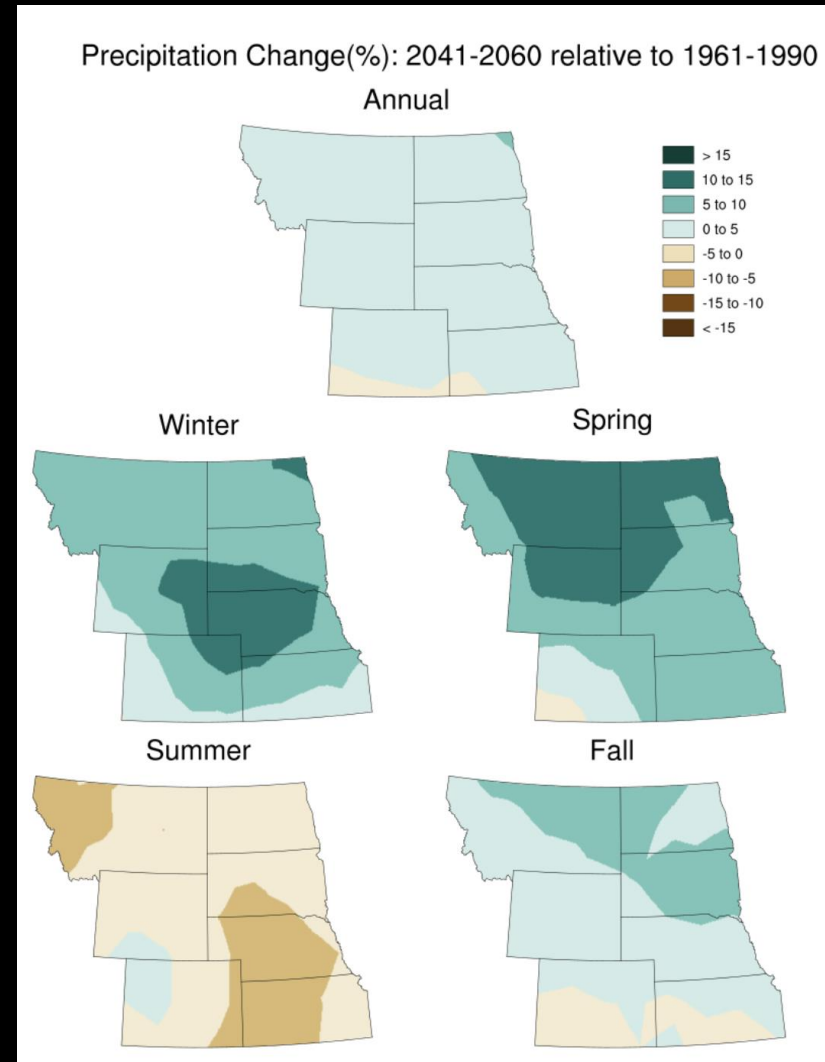


Data: 28 CMIP5 GCMs under a medium emissions scenario (RCP 4.5)

# Precipitation Projections

## Projected Precipitation Change by 2050

- ❖ Annual precipitation is expected to increase with largest increases in spring and winter
- ❖ Plausible decreases in summer precipitation by as much as -10%. Less agreement across models for precipitation changes in summer and fall
- ❖ High confidence that future storms and precipitation events will be more extreme



Data: 28 CMIP5 GCMs under a medium emissions scenario (RCP 4.5)

# Aridification & Drought

Atmospheric Thirst is Increasing!!!

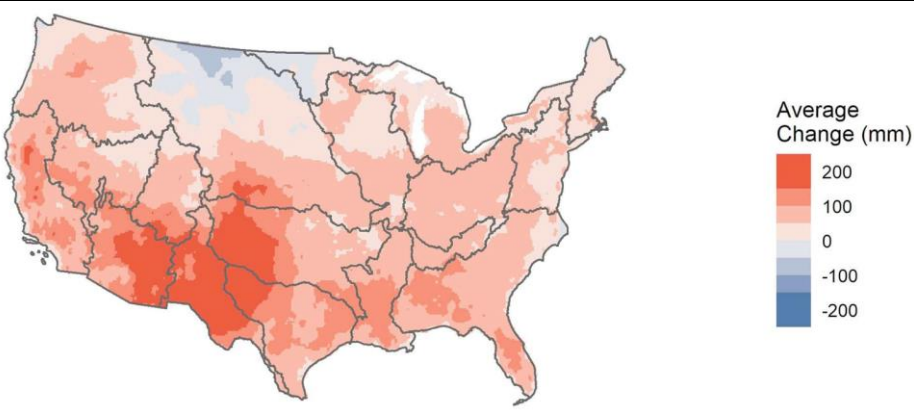
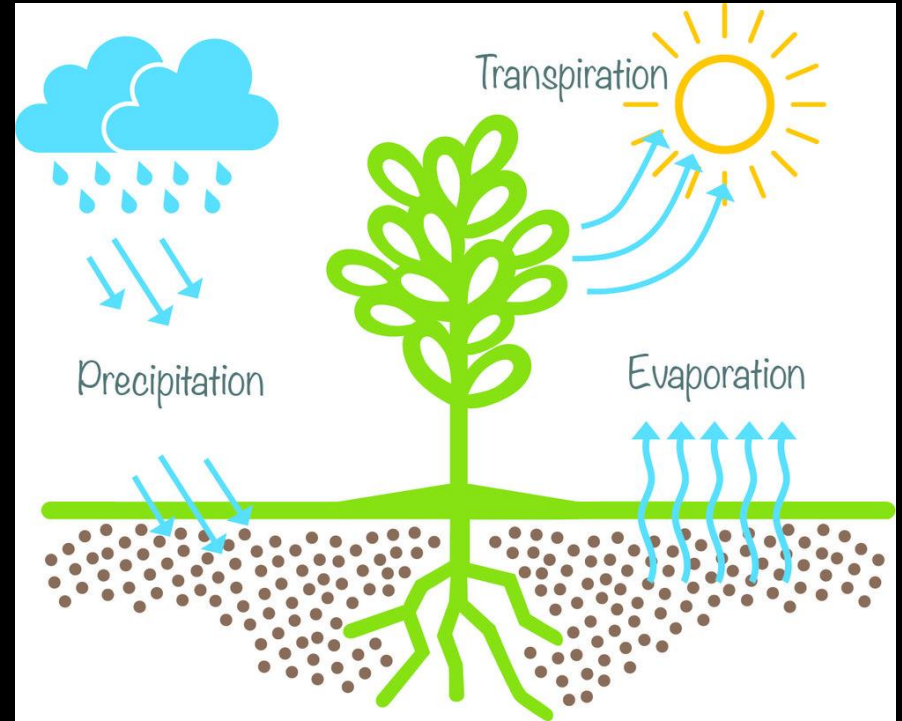


Figure showing changes in atmospheric thirst, measured in terms of reference evapotranspiration (mm), from 1980-2020. The largest changes are centered over the Rio Grande region of the southwestern U.S. Credit: DRI.

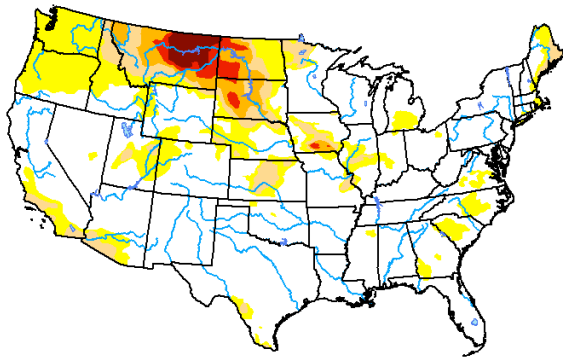
Water available on the land is a difference between precipitation and evapotranspiration



# Increased Risk of Flash Droughts

## U.S. Drought Monitor Contiguous U.S. (CONUS)

August 29, 2017  
(Released Thursday, Aug. 31, 2017)  
Valid 8 a.m. EDT



### Intensity:

- None
- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. For more information on the Drought Monitor, go to <https://droughtmonitor.unl.edu/About.aspx>

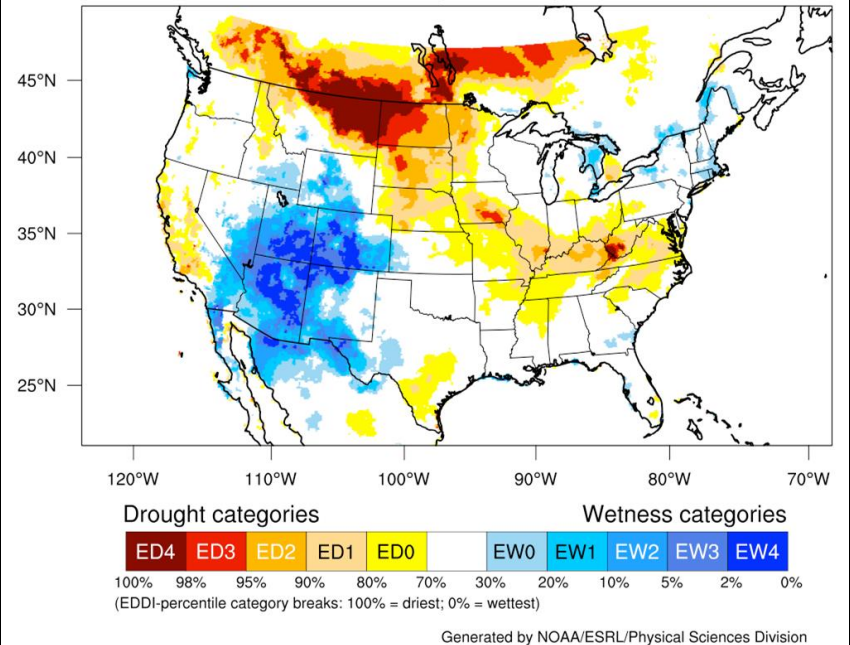
### Author:

Chris Fenimore  
NCEI/NESDIS/NOAA



[droughtmonitor.unl.edu](http://droughtmonitor.unl.edu)

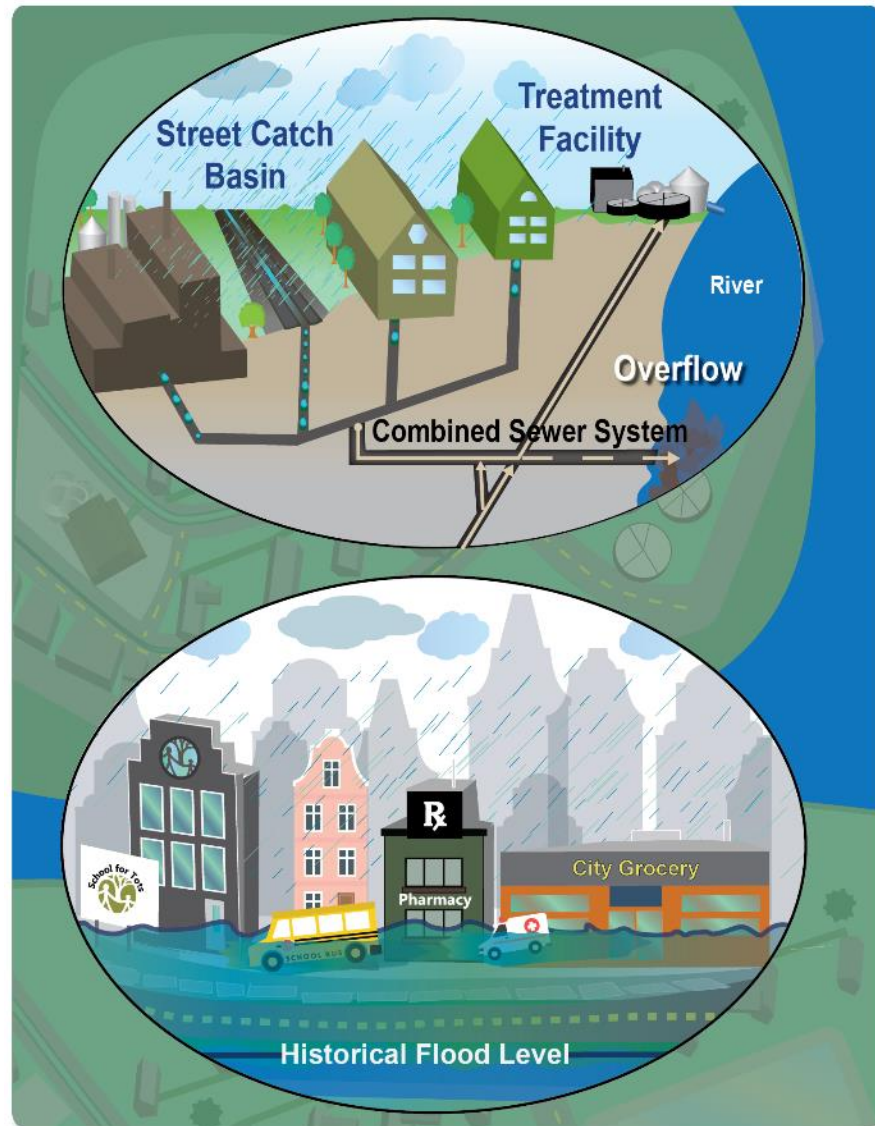
## 1-month EDDI categories for July 31, 2017



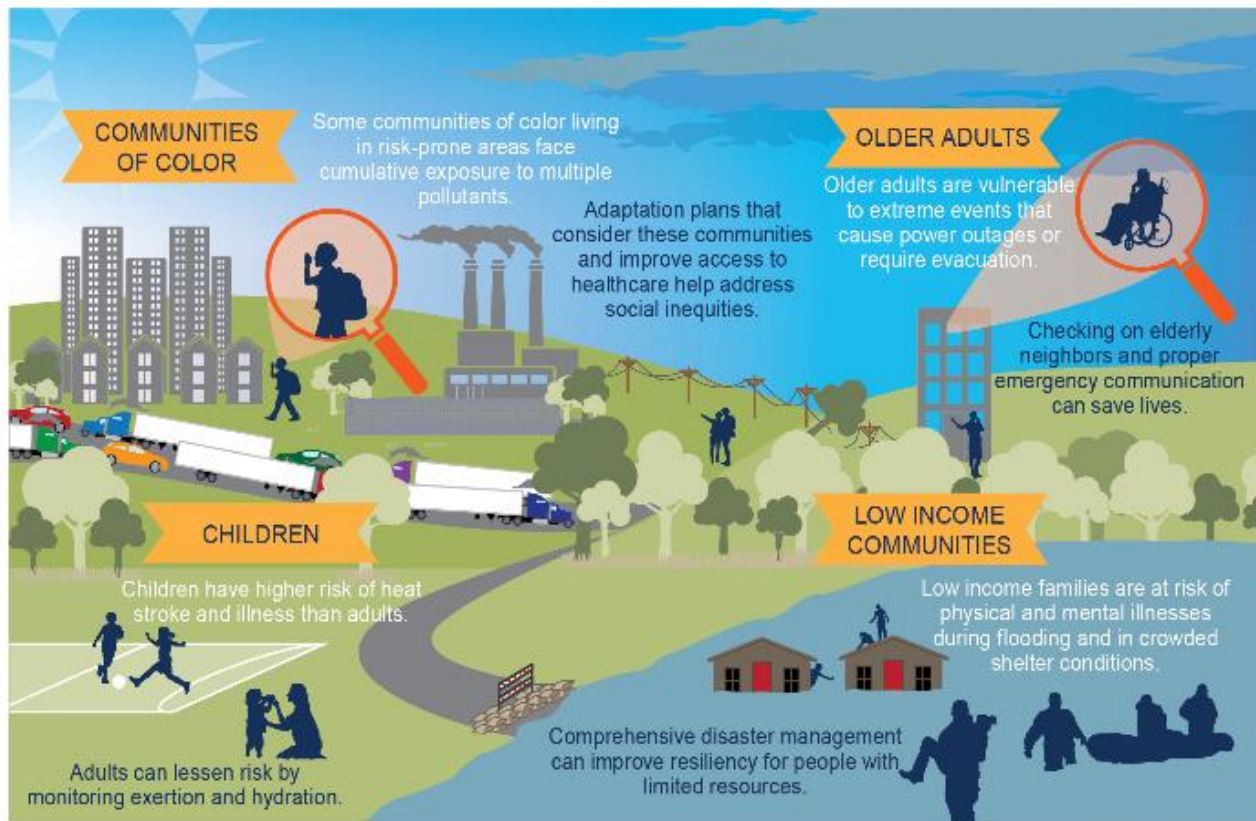
Droughts are found to be developing (drought onset) at a faster rate [globally] in recent decades (Qing and others, 2022)

## Fig. 11.6: Cascading Consequences of Heavy Rainfall for Urban Systems

With heavy downpours increasing nationally, urban areas experience costly impacts. (top) In cities with combined sewer systems, storm water runoff flows into pipes containing sewage from homes and industrial wastewater. Intense rainfall can overwhelm the system so untreated wastewater overflows into rivers. Overflows are a water pollution concern and increase risk of exposure to waterborne diseases. (bottom) Intense rainfall can also result in localized flooding. Closed roads and disrupted mass transit prevent residents from going to work or school and first responders from reaching those in need. Home and commercial property owners may need to make costly repairs, and businesses may lose revenue. *Source: EPA.*







**Fig. 14.2: Vulnerable Populations**

Examples of populations at higher risk of exposure to adverse climate-related health threats are shown along with adaptation measures that can help address disproportionate impacts. When considering the full range of threats from climate change as well as other environmental exposures, these groups are among the most exposed, most sensitive, and have the least individual and community resources to prepare for and respond to health threats. White text indicates the risks faced by those communities, while dark text indicates actions that can be taken to reduce those risks. *Source: EPA.*

**Free, authoritative online sources of  
information about climate change,  
impacts, and projections.**

# For More “Real-time Climate” Information

- Monthly North Central U.S. Climate Summary and Outlook Webinar Series
  - 3<sup>rd</sup> Thursday of each month
- Quarterly Climate Summary and Outlook
  - Midwest, Great Lakes, Missouri Basin states
- Regional Climate Services email list: [doug.kluck@noaa.gov](mailto:doug.kluck@noaa.gov)



# Climate Mapping For Resilience And Adaptation (CMRA)



CMRA

Introduction

Current Hazards

Assessment Tool

Hazard Information

Federal Policies

Open Data

## Wildfire

Active fires **86**

Source: National Interagency Fire Center

## Drought

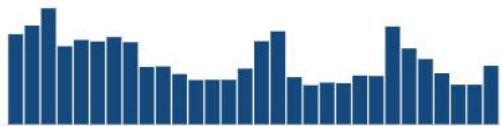
People experiencing drought **74,313,243**

Source: NOAA/NIDIS Drought.gov

## Inland Flooding

People under flood alerts **11,287,621**

Last 30 days



Source: NOAA National Weather Service

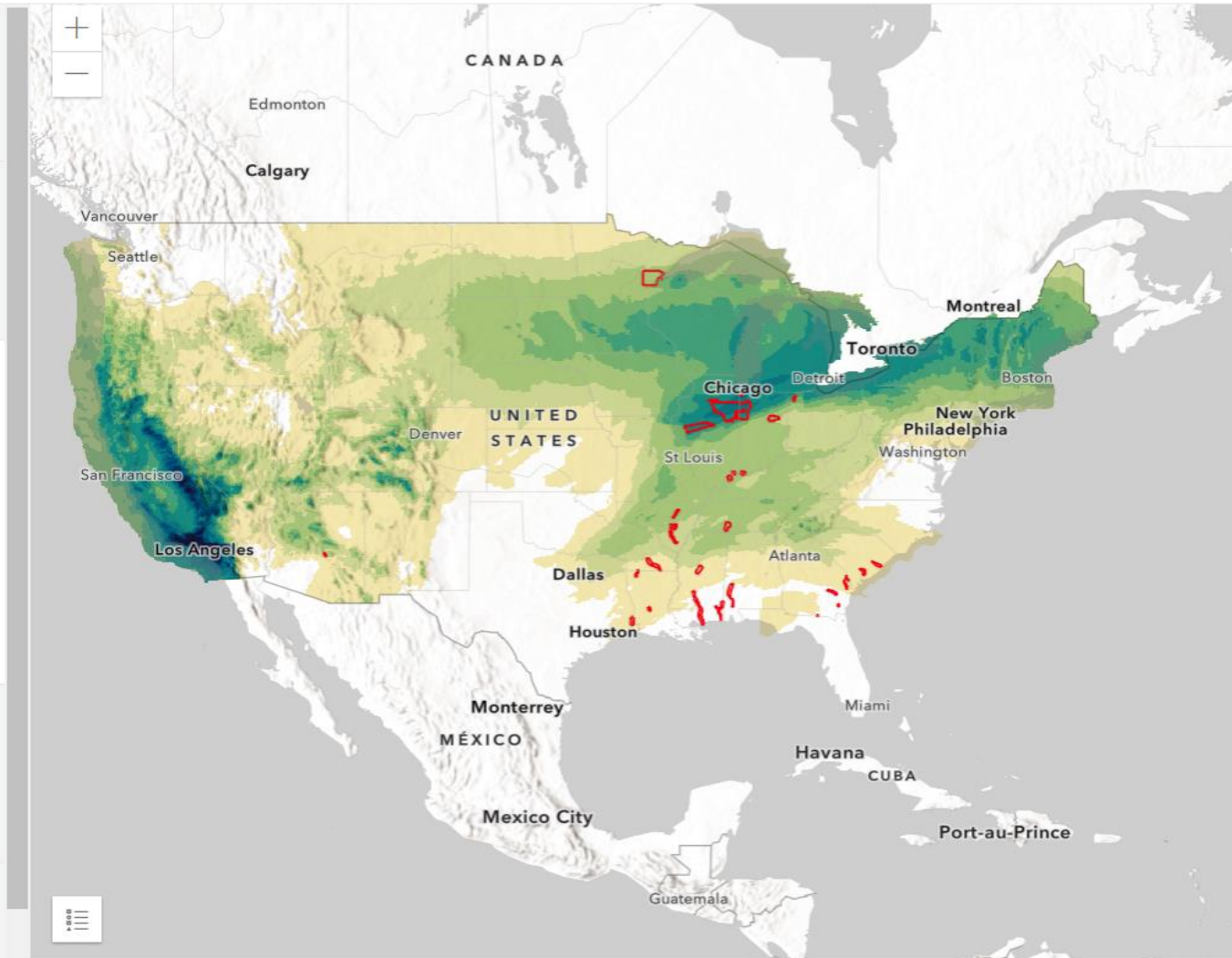
## Coastal Flooding

People under flood alerts **0**

Source: NOAA National Weather Service

## Extreme Heat

People under heat alerts **0**



Lincoln, NE

16.7% of Population in Disadvantaged Communities

Building Code: Resistant

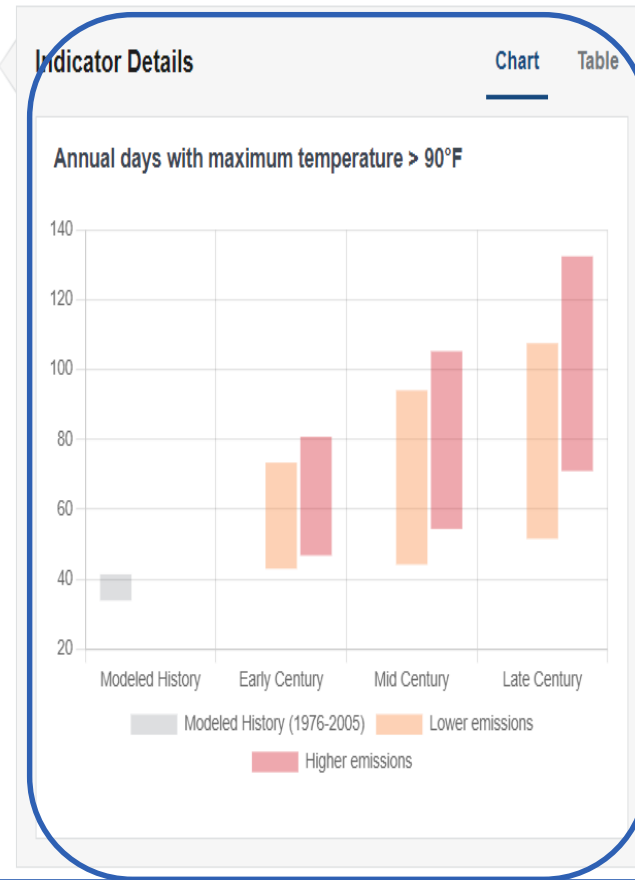
Climate Projections | Map Exploration

Nebraska Game & Parks Commission, Esri, HERE, Garmin, FAO, NOAA, USGS, EPA, NPS | Esri, USGS Powered by

- Climate Hazards
- Extreme Heat
  - Drought
  - Wildfire
  - Flooding
  - Coastal Inundation

Climate Projections for Early Century (2015-2044) Lower emissions Higher emissions

Indicator	Lower emissions	Higher emissions
Annual days with maximum temperature > 90°F	58.5 Days + 21.7 since 1976-2005	61.5 Days + 24.7 since 1976-2005
Annual days with maximum temperature > 95°F	28.1 Days + 14.3 since 1976-2005	30.9 Days + 17.2 since 1976-2005
Annual days with maximum temperature > 100°F	9.4 Days + 6.3 since 1976-2005	11.2 Days + 8.0 since 1976-2005
Annual days with maximum temperature > 105°F	1.8 Days + 1.5 since 1976-2005	2.4 Days + 2.1 since 1976-2005
Annual single highest maximum temperature	104.9 °F + 3.3 since 1976-2005	105.4 °F + 3.8 since 1976-2005
Annual highest maximum temperature averaged over a 5-day	99.7 °F	100.3 °F



Lancaster County, NE

Select a geography: Census Tract County Tribal Land

Lancaster County, NE

### 76.7 Days

Annual days with maximum temperature > 95°F

Zoom to

16.7% of Population in Disadvantaged Communities

Building Cost Assistant



Climate Projections

Map Exploration

Hazards

Extreme Heat

Indicators



Annual days with maximum temperature > 95°F

76.7 Days Annual number of days with a maximum temperature greater than 95°F

Timeframe

Late Century (2070-2099)

Prediction Model

Lower emissions Higher emissions

# 5-page reports are .html files that can be bookmarked, shared, or printed

**Hazard Report**  
**Extreme Heat**

Lac qui Parle County, Minnesota

National Risk Index Rating  
⊖ Relatively Low

Total Population  
⊖ 6,719

Building Codes Hazard Resistance  
⊖ Partially Resistant

% Population Disadvantaged  
⊖ 0.00%

[Explore additional data](#)

U.S. Climate Resilience Toolkit  
Source: Census Bureau, CEQ, Esri, FEMA, MRLC, NOAA, UCSD

**Historical Risk**  
according to the FEMA National Risk Index

Extreme Heat Annualized Frequency  
⊖ 1.24

Expected Annual Loss Rating  
⊖ Relatively Low

Expected Annual Loss Total (\$)  
⊖ \$75,804.49

**Hazard Report**  
**Drought**

Lac qui Parle County, Minnesota

National Risk Index Rating  
⊖ Relatively Moderate

Total Population  
⊖ 6,719

Building Codes Hazard Resistance  
⊖ Partially Resistant

% Population Disadvantaged  
⊖ 0.00%

[Explore additional data](#)

U.S. Climate Resilience Toolkit  
Source: Census Bureau, CEQ, Esri, FEMA, MRLC, NOAA, UCSD

**Historical Risk**  
according to the FEMA National Risk Index

Drought Annualized Frequency  
⊖ 8.68

Expected Annual Loss Rating  
⊖ Relatively Moderate

Expected Annual Loss Total (\$)  
⊖ \$1,698,483.81

**Hazard Report**  
**Wildfire**

Lac qui Parle County, Minnesota

National Risk Index Rating  
⊖ Very Low

Total Population  
⊖ 6,719

Building Codes Hazard Resistance  
⊖ Partially Resistant

% Population Disadvantaged  
⊖ 0.00%

[Explore additional data](#)

U.S. Climate Resilience Toolkit  
Source: Census Bureau, CEQ, Esri, FEMA, MRLC, NOAA, UCSD

**Historical Risk**  
according to the FEMA National Risk Index

Wildfire Annualized Frequency  
⊖ 0.00

Expected Annual Loss Rating  
⊖ Very Low

Wildfire Hazard Potential (Mean)  
⊖ 36.67

Expected Annual Loss Total (\$)  
⊖ \$7,202.21

**Future Climate**

Indicator	Early Century (2035)		Mid Century (2050)		Late Century (2085)	
	Low Emissions	High Emissions	Low Emissions	High Emissions	Low Emissions	High Emissions
	Min - Max	Min - Max	Min - Max	Min - Max	Min - Max	Min - Max
<b>Annual days with:</b>						
Maximum temperature > 100°F	3 days 2 - 4	4 days 2 - 5	6 days 4 - 7	9 days 6 - 11	9 days 6 - 7	27 days 22 - 30
Maximum temperature > 90°F	34 days 28 - 38	37 days 31 - 40	44 days 37 - 48	52 days 46 - 57	54 days 47 - 58	81 days 74 - 85
<b>Daily temperature:</b>						
Average daily minimum temperature °F	37 °F 36 - 38	37 °F 37 - 38	38 °F 38 - 39	39 °F 39 - 40	40 °F 39 - 40	44 °F 43 - 45
Average daily maximum temperature °F	37 °F 58 - 60	60 °F 59 - 60	38 °F 60 - 61	62 °F 61 - 62	40 °F 61 - 63	66 °F 65 - 67
<b>Annual temperature:</b>						
Annual single highest maximum temperature °F	102 °F 101 - 103	102 °F 102 - 103	104 °F 103 - 105	105 °F 104 - 106	105 °F 104 - 106	110 °F 109 - 111
Annual highest maximum temperature averaged over a 5-day period °F	97 °F 96 - 98	98 °F 96 - 98	99 °F 97 - 100	100 °F 99 - 101	101 °F 99 - 101	105 °F 104 - 106
Annual number of dry days	183 days 204 - 176	183 days 203 - 176	183 days 204 - 177	184 days 204 - 177	184 days 204 - 177	186 days 206 - 180
Annual number of days with measurable precipitation (wet days)	182 days 161 - 189	182 days 162 - 189	182 days 161 - 188	181 days 161 - 188	181 days 161 - 188	179 days 159 - 185
Maximum number of consecutive dry days	18 days 17 - 21	18 days 17 - 21	18 days 17 - 21	18 days 17 - 21	19 days 17 - 21	19 days 17 - 21
Maximum number of consecutive wet days	10 days 8 - 10	9 days 8 - 10	9 days 8 - 10	9 days 8 - 10	10 days 9 - 10	10 days 8 - 10

N/A = Data Not Available for the selected area

# Climate.gov, Drought.gov, Weather.gov, Heat.gov

The screenshot shows the Climate.gov homepage. At the top left is the Climate.gov logo with the tagline "SCIENCE & INFORMATION FOR CLIMATE SUSTAINABILITY". To the right are social media icons for Facebook, Twitter, Instagram, and YouTube, and a search bar. Below the navigation menu, there are several featured news items with a large satellite-style image of Earth. A "Global Climate Dashboard" section is visible, featuring a "Tracking climate change and natural variability over time" header and a "Sort by indicator:" dropdown set to "Climate Change". Below this are eight small line and bar charts for: Greenhouse Gases, Arctic Sea Ice, Carbon Dioxide, Mountain Glaciers, Ocean Heat, Sea Level, Spring Snow, and Incoming Sunlight. At the bottom, there are four "POPULAR SECTIONS" with icons and titles: Data Snapshots, Event Tracker, Climate Explorer, and Teaching the NCA.

www.climate.gov

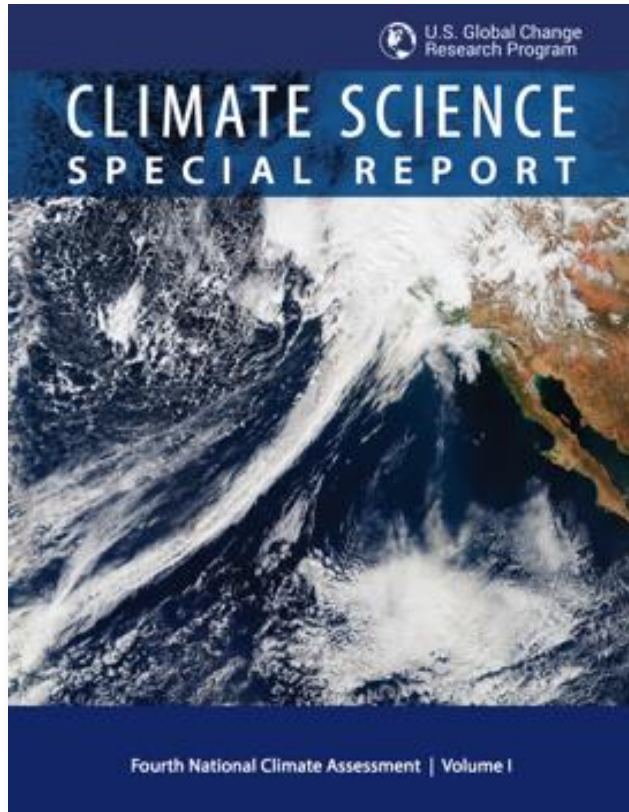
The screenshot shows the U.S. Climate Resilience Toolkit homepage. The background is a dramatic sunset over a body of water. At the top left is the "U.S. Climate Resilience Toolkit" logo. To the right are navigation links for "Steps to Resilience", "Case Studies", "Tools", "Expertise", "Regions", and "Topics", along with a search bar. The main heading reads "Meet the Challenges of a Changing Climate" with a sub-heading "Learn about potential climate hazards so you can protect vulnerable assets." Below this are three white boxes with blue text: "LEARN ABOUT THE STEPS TO RESILIENCE, OUR RISK MANAGEMENT FRAMEWORK >", "READ CASE STUDIES DESCRIBING ON-THE-GROUND EFFORTS TO BUILD RESILIENCE >", and "USE THE CLIMATE EXPLORER TO CHECK CONDITIONS PROJECTED FOR THE FUTURE >". A blue button with white text says "TOUR THE TOOLKIT >". At the bottom right, there is a "MORE" link with a downward arrow.

toolkit.climate.gov

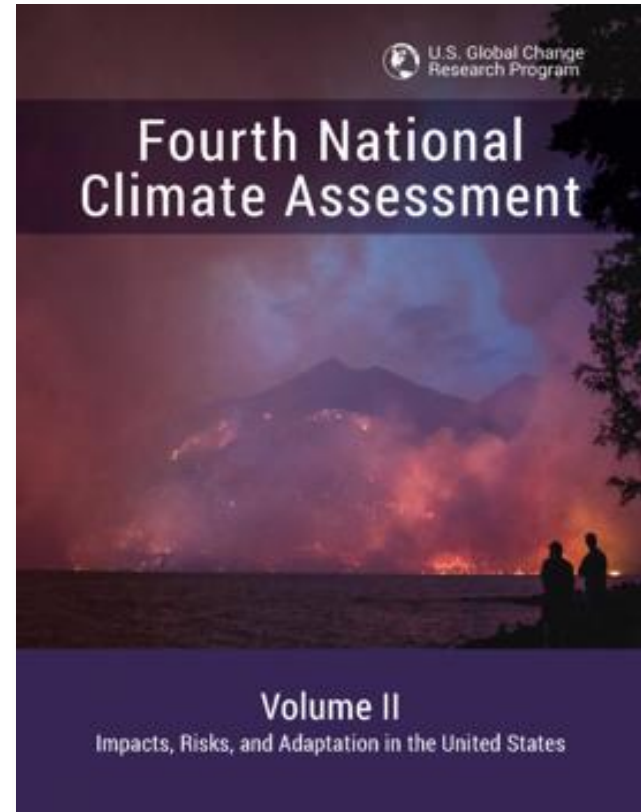
Climate Resilience Toolkit: <https://toolkit.climate.gov/>



# U.S. Global Change Research Program (USGCRP)



[science2017.globalchange.gov](https://science2017.globalchange.gov)



[globalchange.gov/nca4](https://globalchange.gov/nca4)

**National Climate Assessment 5.0 due by the end of 2023**

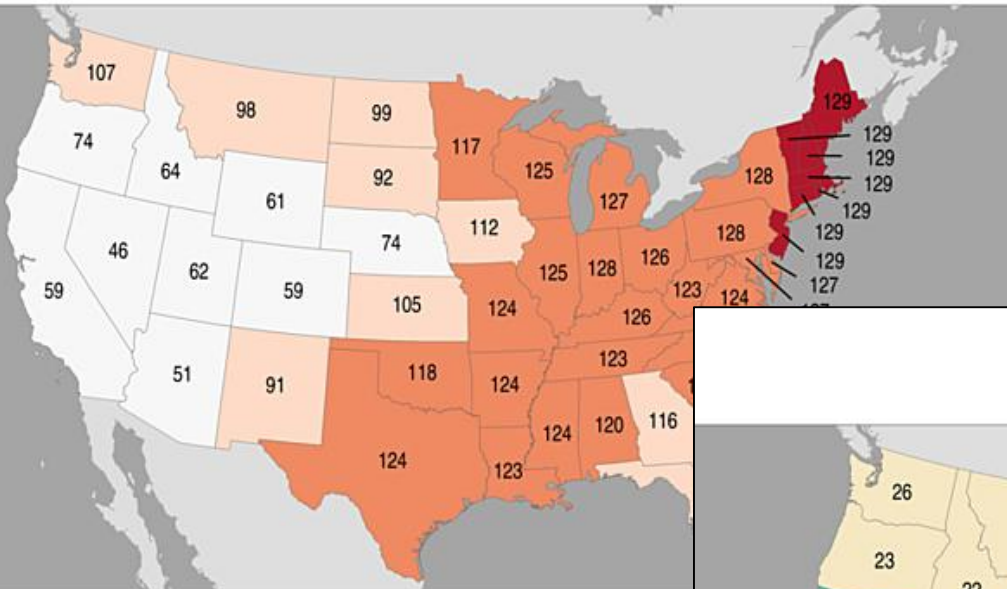
# Local Trends, Current Conditions and Outlooks



# January 2023 Rankings

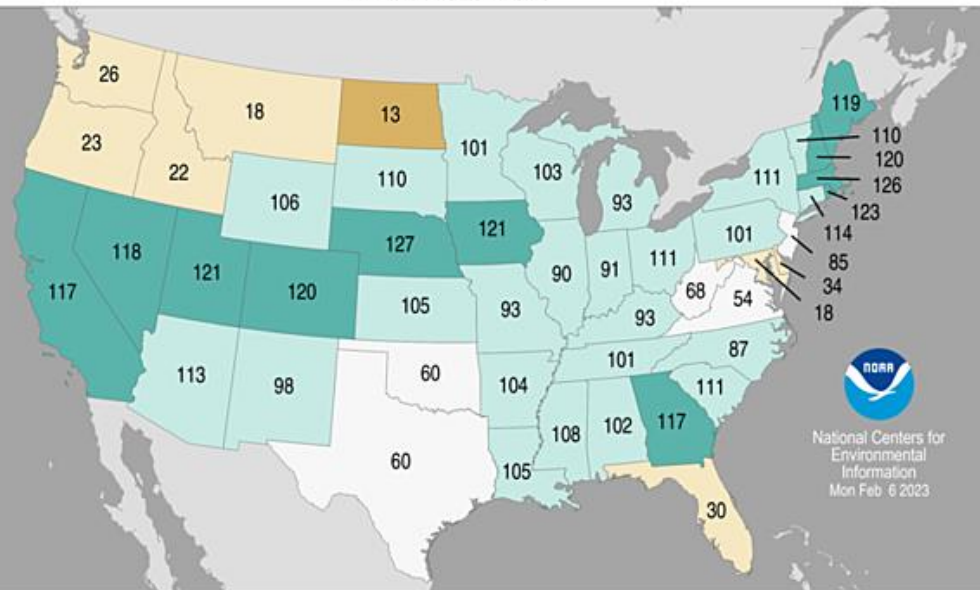
## Statewide Average Temperature Ranks

January 2023  
Period: 1895–2023



## Statewide Precipitation Ranks

January 2023  
Period: 1895–2023



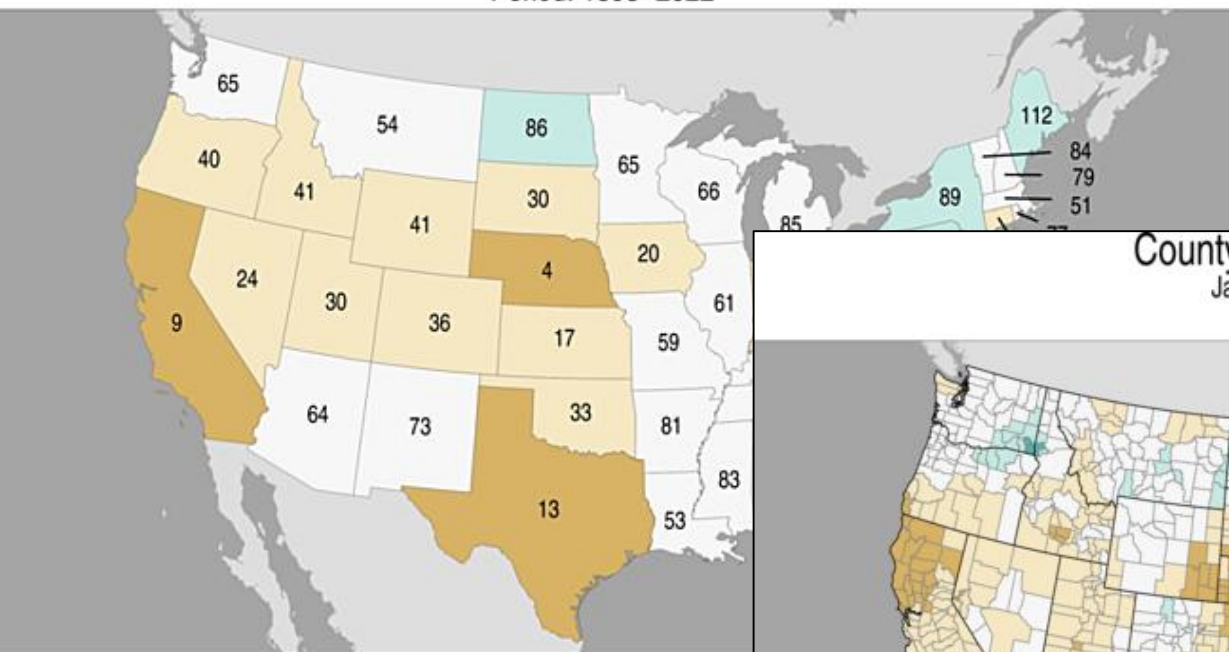
National Centers for  
Environmental  
Information  
Mon Feb 6 2023

# 2022 Precipitation

## Statewide Precipitation Ranks

January – December 2022

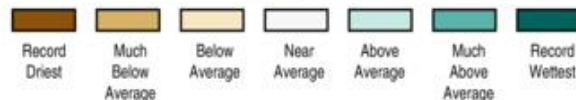
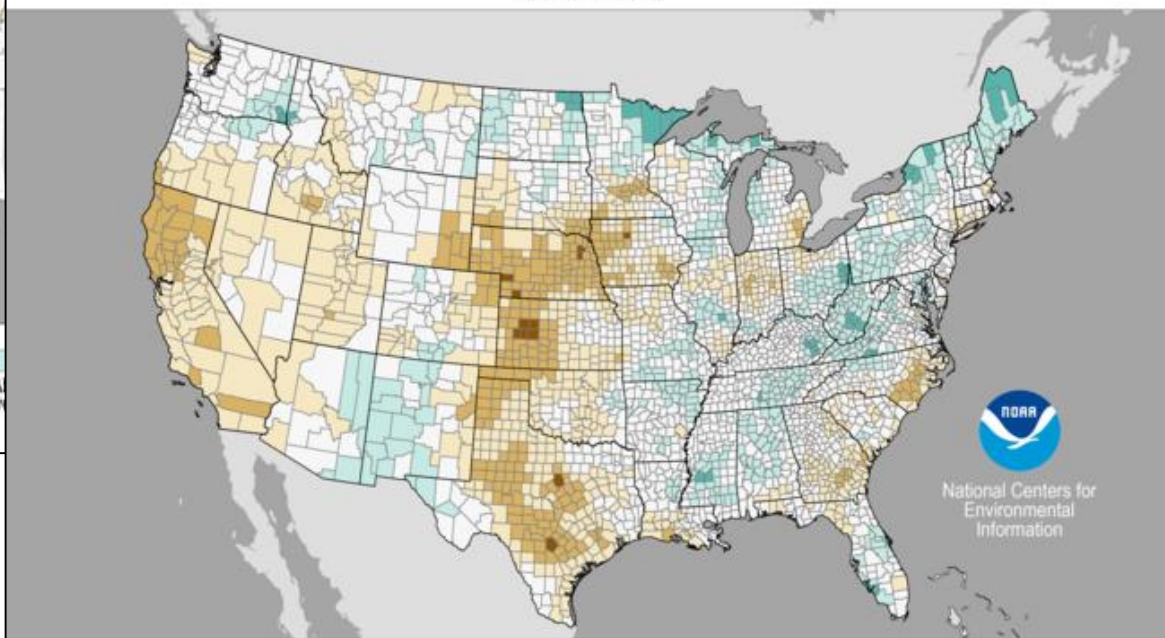
Period: 1895–2022



## County Precipitation Ranks

January–December 2022

Period: 1895–2022



National Centers for Environmental Information

2022 - 2nd driest August - December

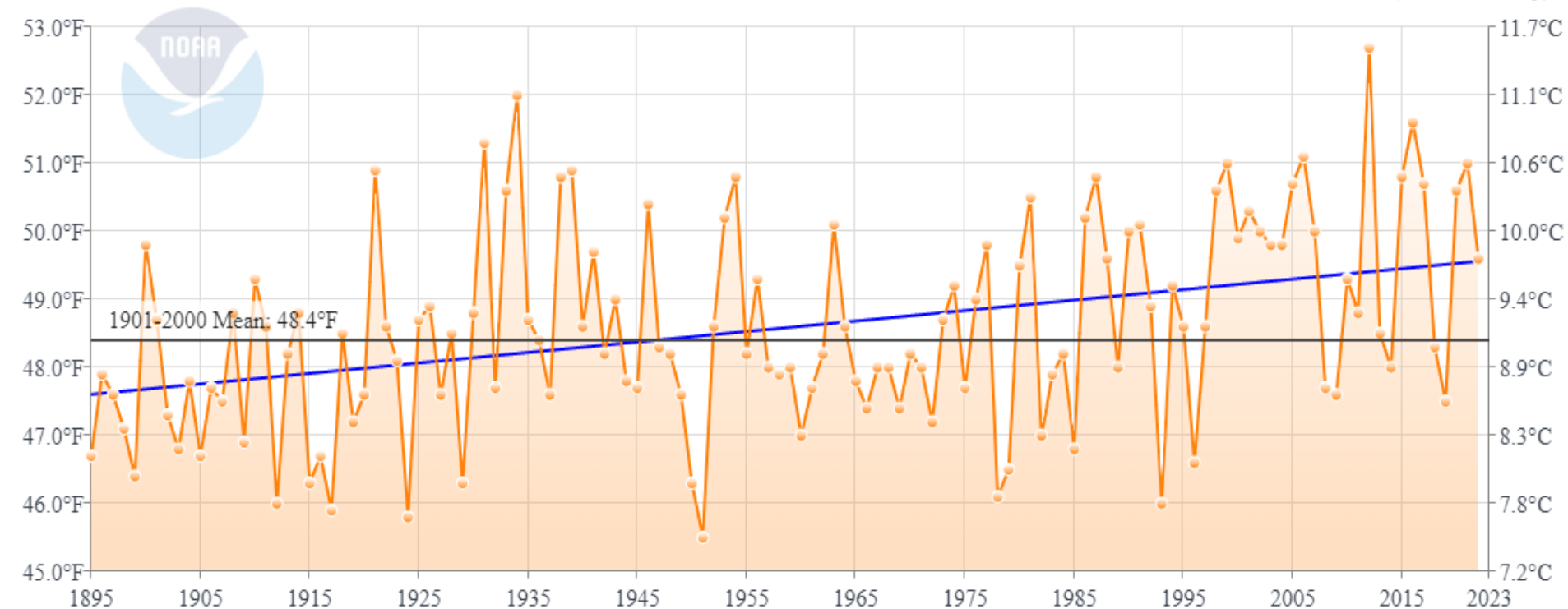
# Nebraska Temperature Trends

<https://www.ncei.noaa.gov/access/monitoring/climate-at-a-glance/>

## Nebraska Average Temperature

January-December

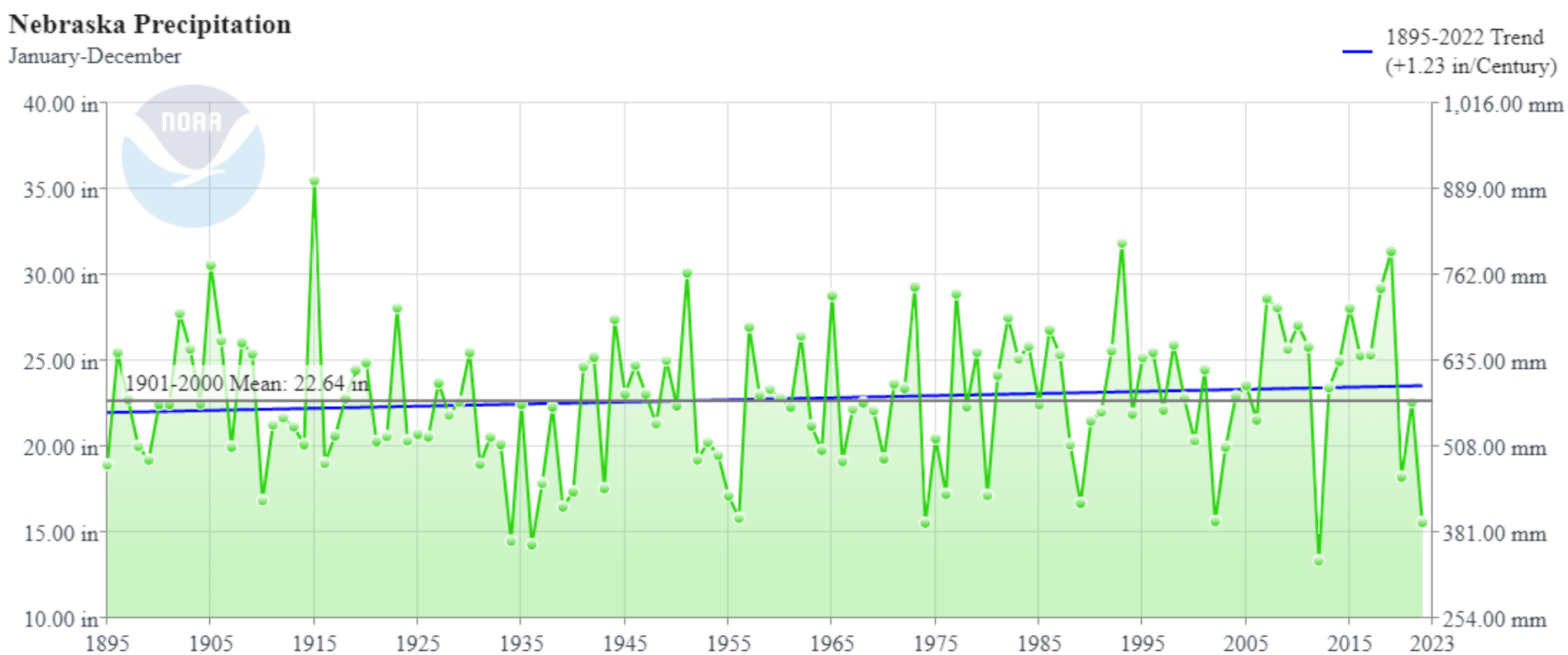
1895-2022 Trend  
(+1.5°F/Century)



**Panhandle: +2.2F/Century**  
**Southeast: +1.3F/Century**

# Nebraska Precipitation Trends

<https://www.ncei.noaa.gov/access/monitoring/climate-at-a-glance/>

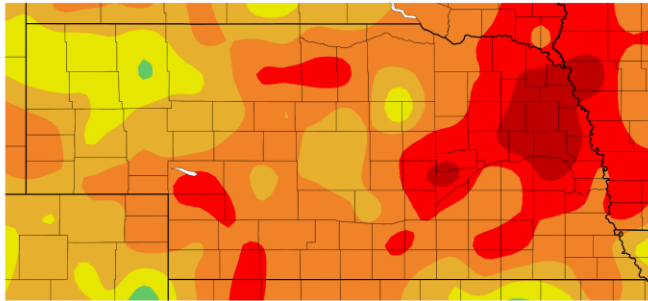


**Southeast: +1.36"**  
**Panhandle: +0.14**

**Have precipitation increases been able to keep up with rising temperatures?**

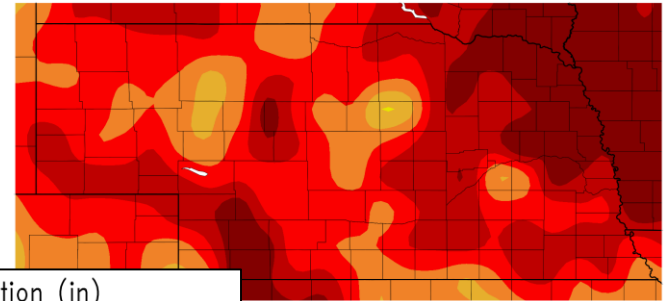
# Precipitation % of Normal and deficit: Last 3, 2 and 1 years

Departure from Normal Precipitation (in)  
2/21/2022 - 2/20/2023



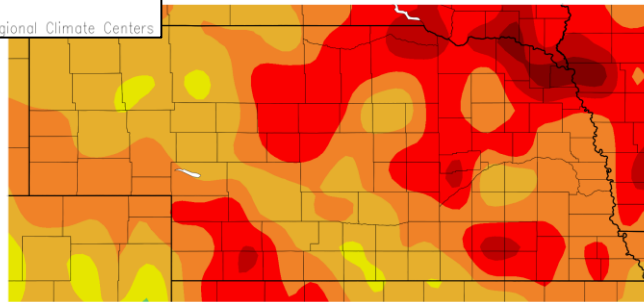
**12 Months**

Departure from Normal Precipitation (in)  
2/22/2020 - 2/21/2023



**24 Months**

Departure from Normal Precipitation (in)  
2/22/2021 - 2/21/2023



**36 Months**

Generated 2/21/2023 at HPRCC using provisional data.

NOAA Regional Climate Centers

Generated 2/22/2023 at HPRCC using provisional data.

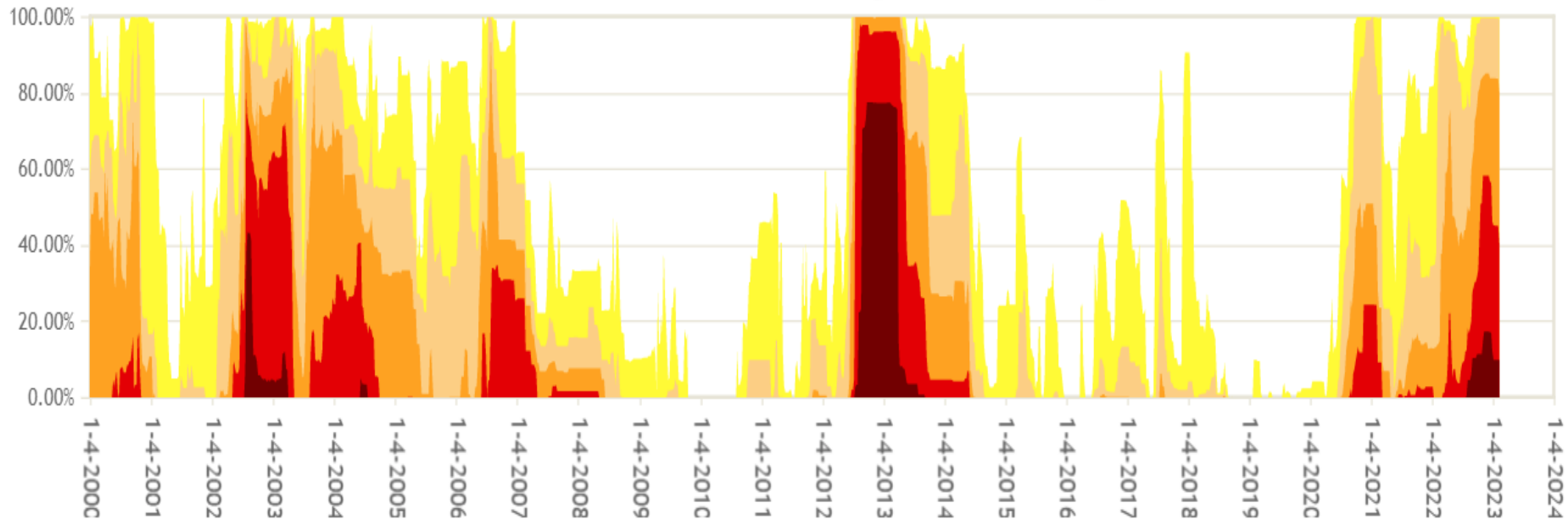
NOAA Regional Climate Centers

Generated 2/22/2023 at HPRCC using provisional data.

NOAA Regional Climate Centers

# 22 Years of Drought: Nebraska

Nebraska Percent Area in U.S. Drought Monitor Categories

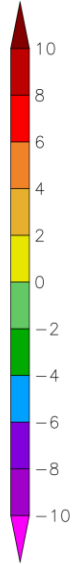
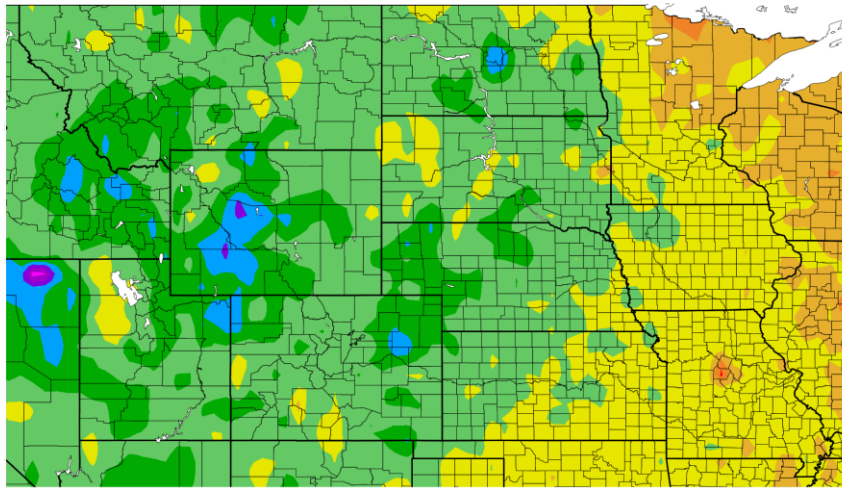




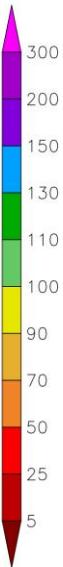
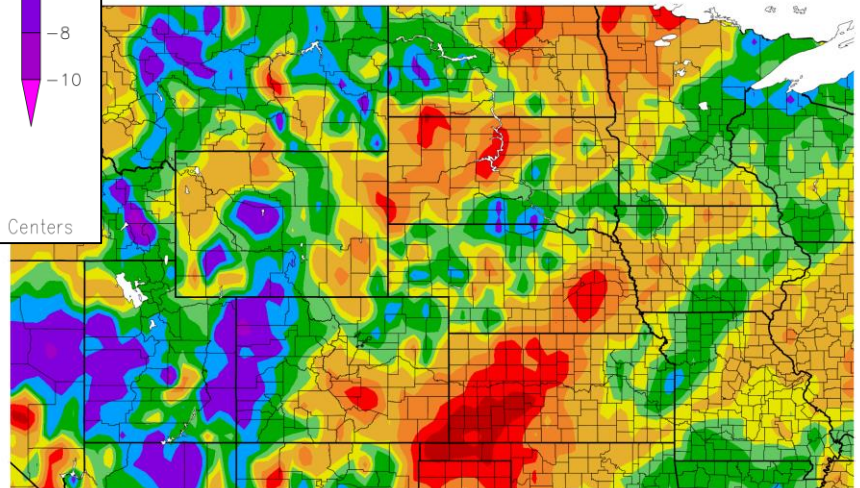


# Temperature & Precipitation Since October 1<sup>st</sup>, 2022

Departure from Normal Temperature (F)  
10/1/2022 - 2/20/2023



Percent of Normal Precipitation (%)  
10/1/2022 - 2/20/2023



Generated 2/21/2023 at HPRCC using provisional data.

NOAA Regional Climate Centers

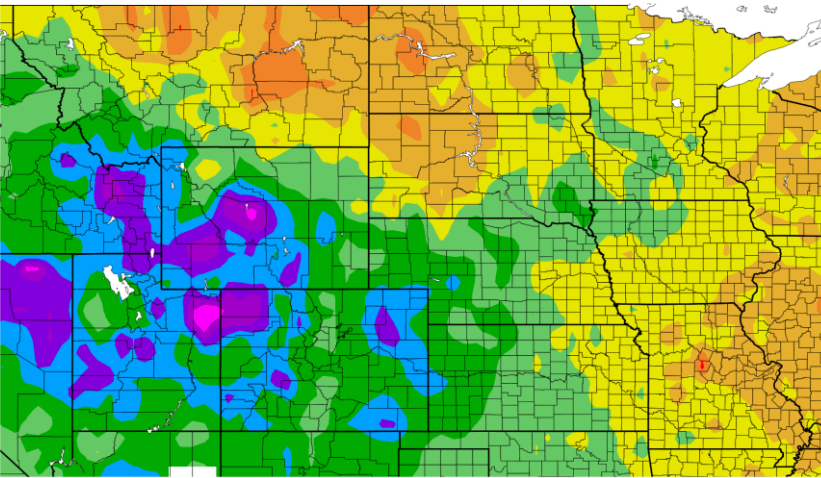
Generated 2/21/2023 at HPRCC using provisional data.

NOAA Regional Climate Centers



# Temperature & Precipitation Last 30 days

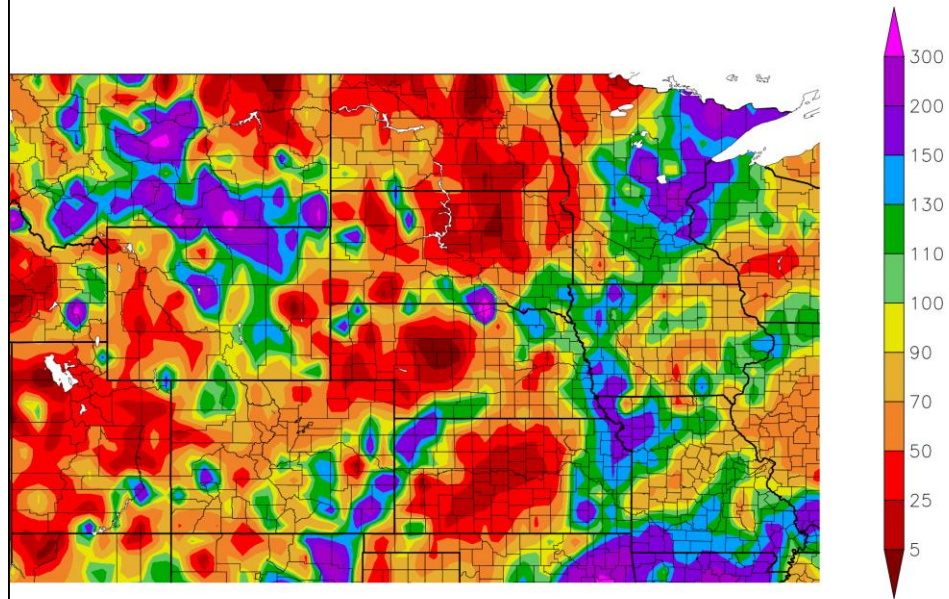
Departure from Normal Temperature (F)  
1/23/2023 - 2/21/2023



Generated 2/22/2023 at HPRCC using provisional data.

NOAA Regional Climate Centers

Percent of Normal Precipitation (%)  
1/23/2023 - 2/21/2023



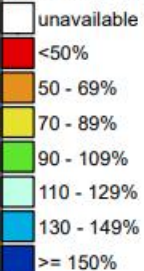
Generated 2/22/2023 at HPRCC using provisional data.

NOAA Regional Climate Centers

# Westwide SNOTEL Current Snow Water Equivalent (SWE) % of Normal

Feb 22, 2023

Current Snow Water Equivalent (SWE) Basin-wide Percent of 1991-2020 Median



\* Data unavailable at time of posting or measurement is not representative at this time of year

Provisional data subject to revision



Miles

# Mountain Snowpack (snow water equivalent % of normal)

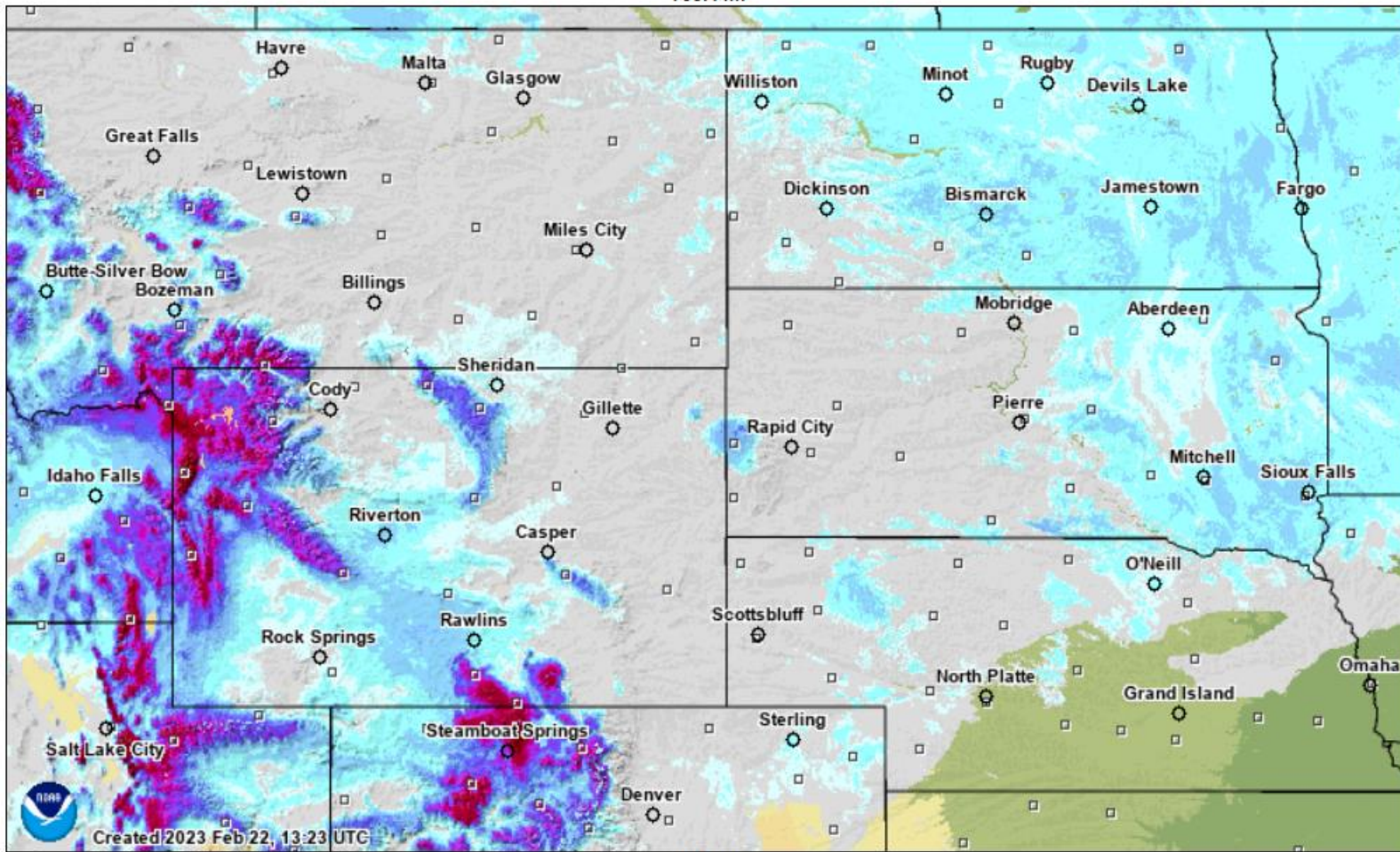
58



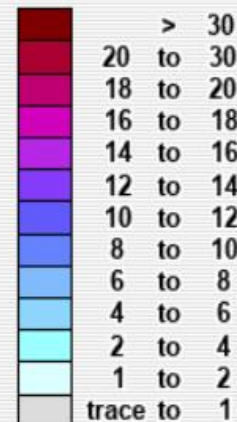
# Plains Snowpack (snow water equivalent)

(February 22, 2023)

Modeled Snow Water Equivalent forecasted for 2023 February 22, 18:00 UTC  
799.4 mi



Inches of water equivalent



Not Estimated

Elevation in feet



Created 2023 Feb 22, 13:23 UTC

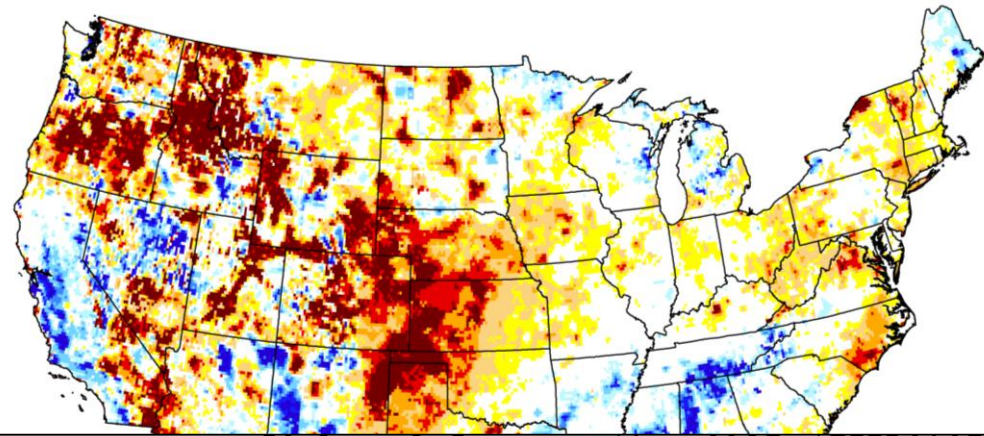
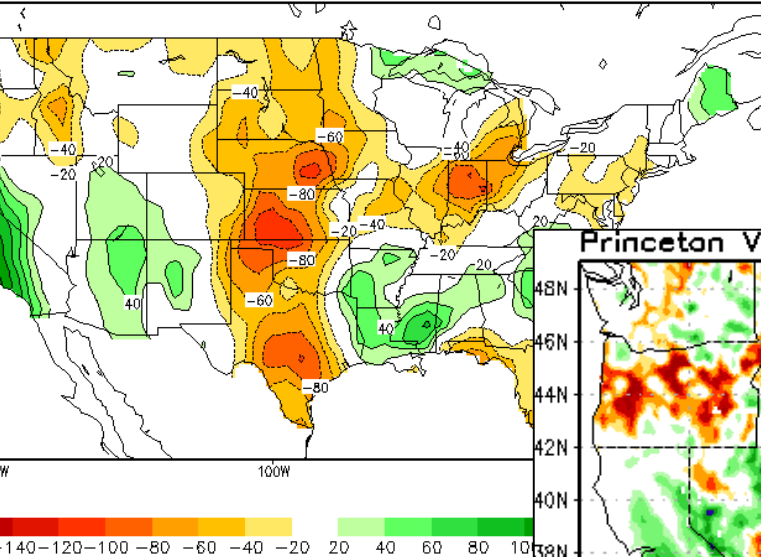
# Soil Moisture



GRACE-Based Shallow Groundwater Drought Indicator

February 20, 2023

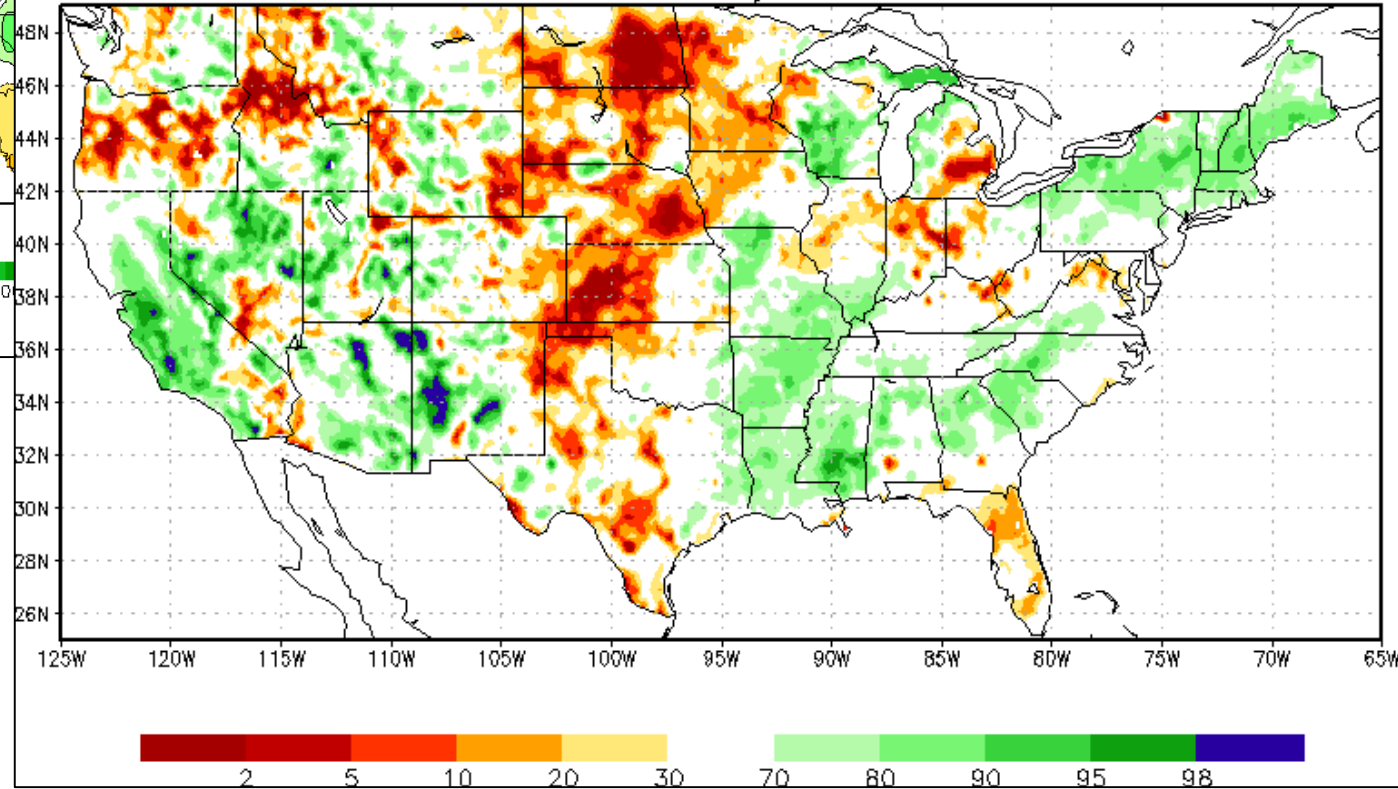
Calculated Soil Moisture Anomaly (mm)  
FEB 21, 2023



Princeton VIC

Last 30 Days SMP

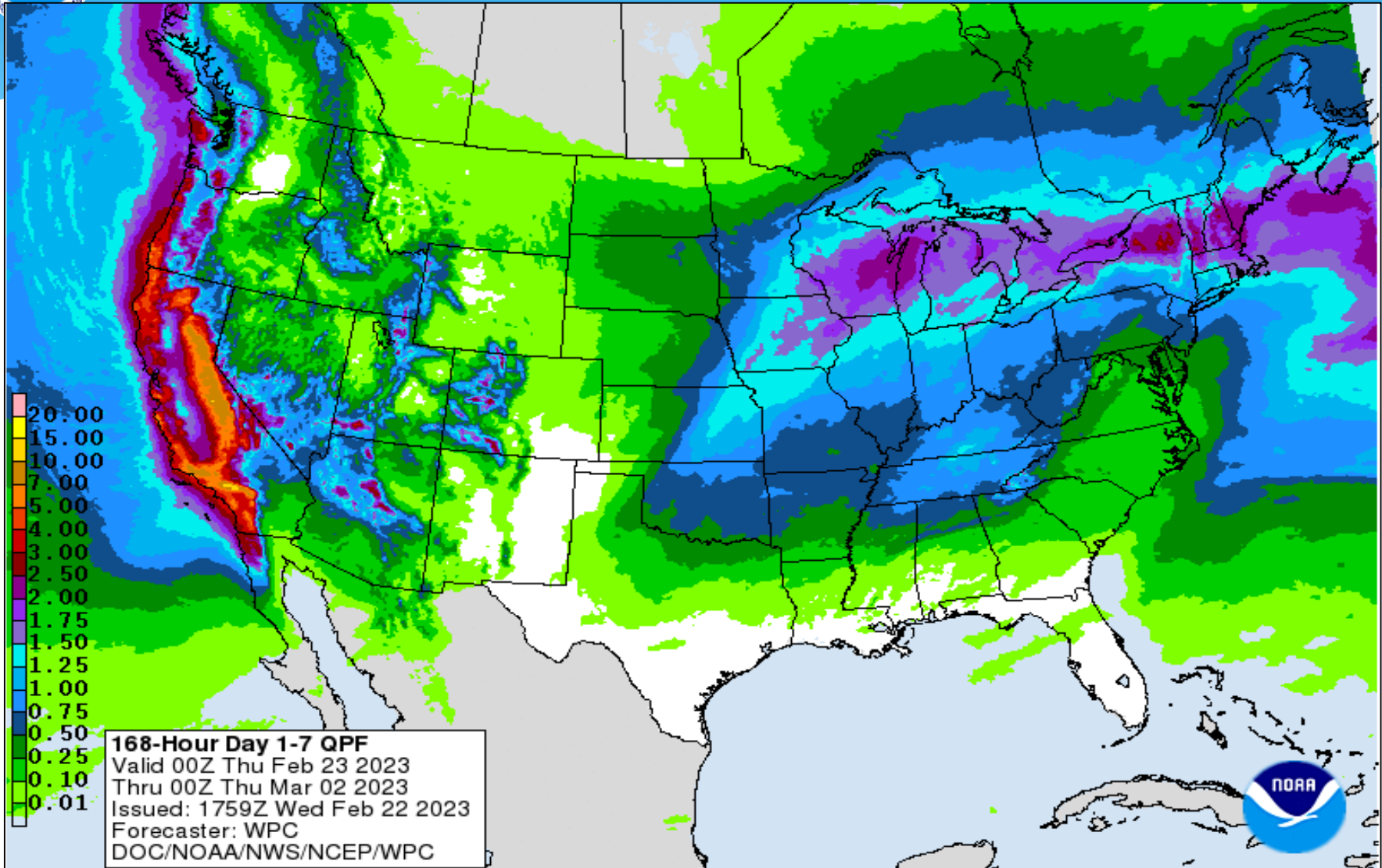
19JAN2023-17FEB2023





# Total Precipitation Outlook Through 3/2/23

61





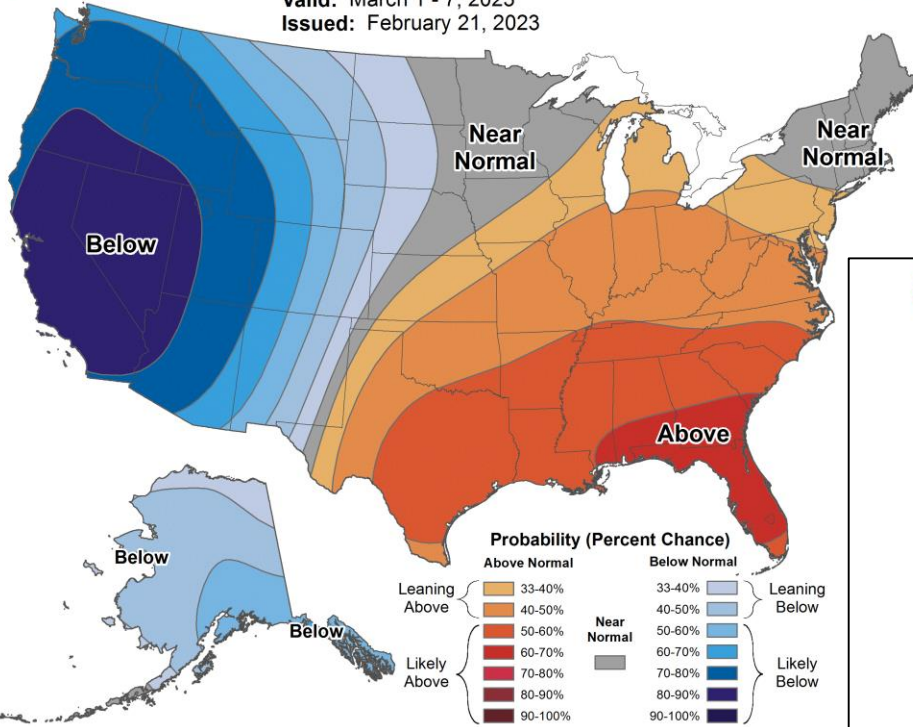
# Week 2 Temperature & Precipitation Outlook (March 1<sup>st</sup> – 7<sup>th</sup>, 2023)



## 8-14 Day Temperature Outlook



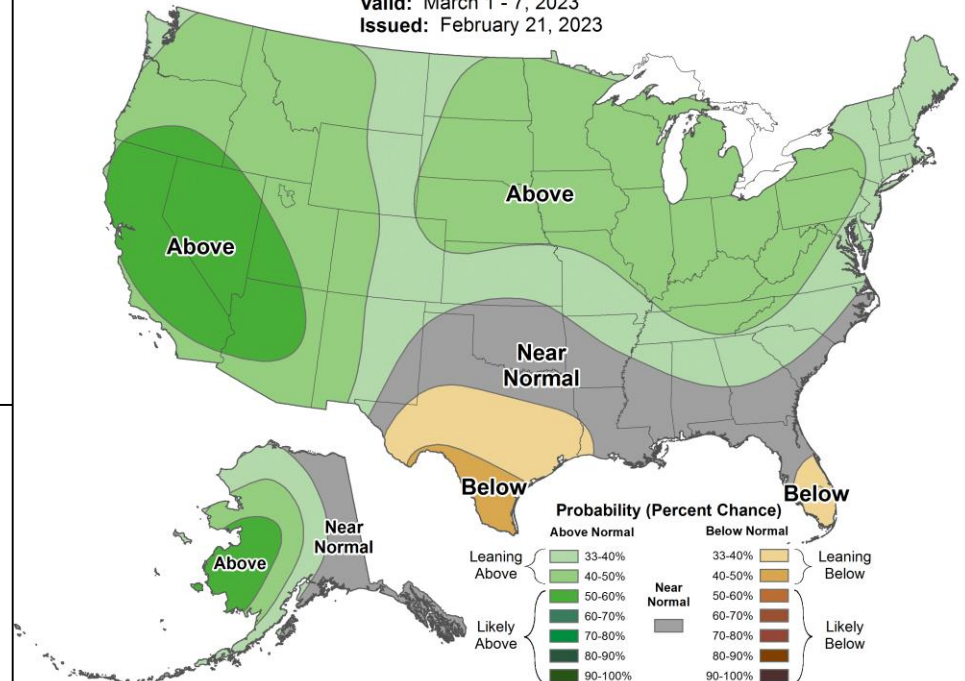
Valid: March 1 - 7, 2023  
Issued: February 21, 2023



## 8-14 Day Precipitation Outlook



Valid: March 1 - 7, 2023  
Issued: February 21, 2023



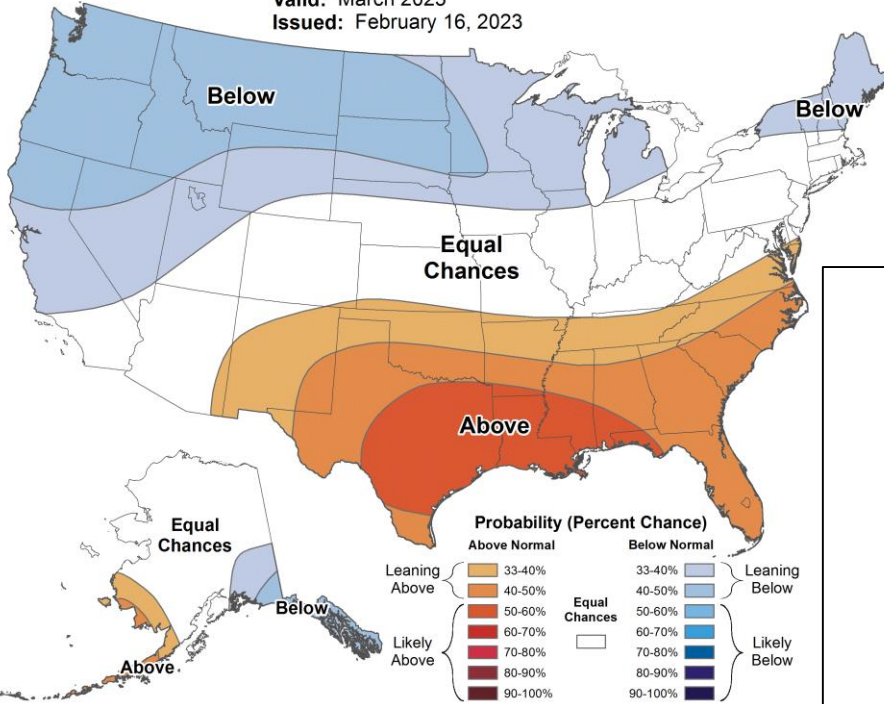
# March 2023 Temperature & Precipitation Outlook



## Monthly Temperature Outlook



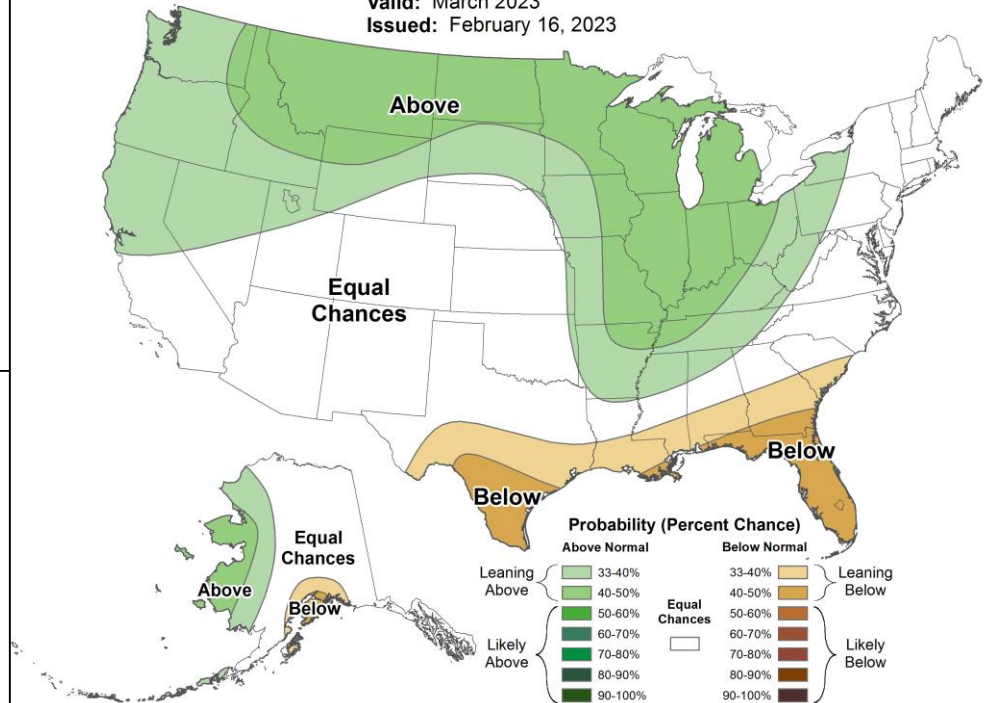
Valid: March 2023  
Issued: February 16, 2023



## Monthly Precipitation Outlook



Valid: March 2023  
Issued: February 16, 2023







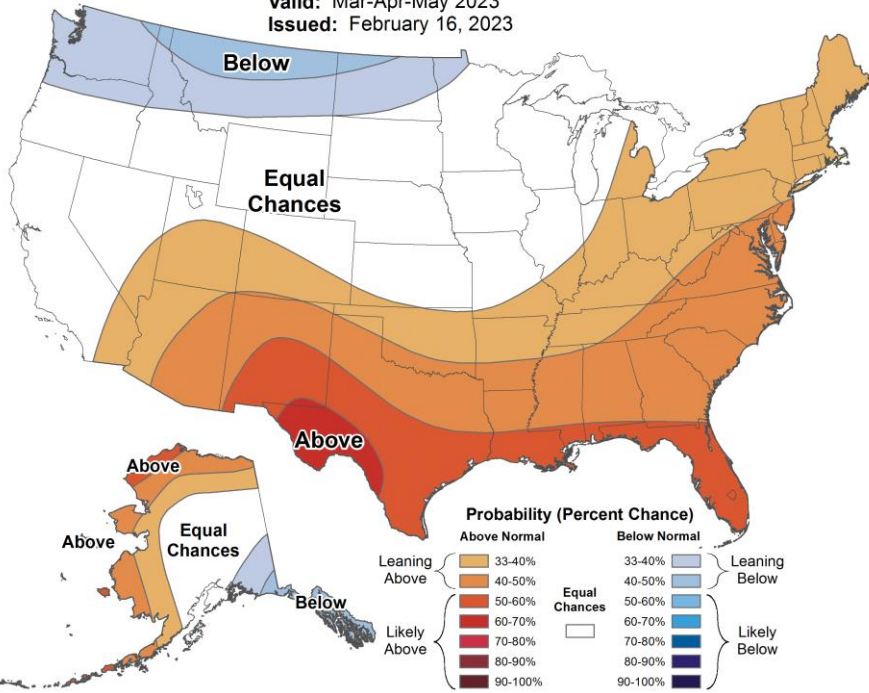
# March - May 2023 Temperature & Precipitation Outlook



## Seasonal Temperature Outlook



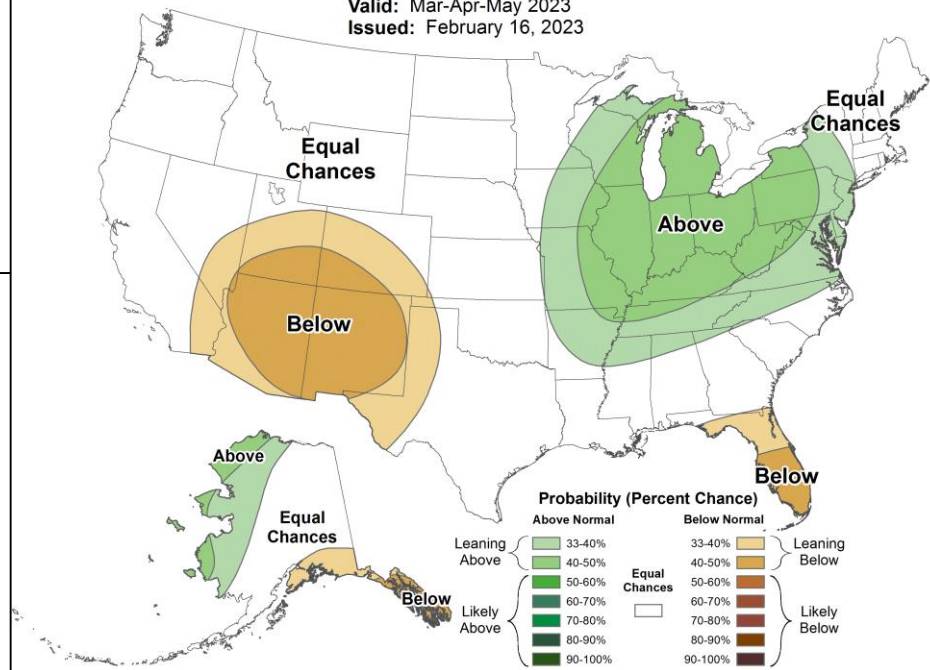
Valid: Mar-Apr-May 2023  
Issued: February 16, 2023



## Seasonal Precipitation Outlook



Valid: Mar-Apr-May 2023  
Issued: February 16, 2023



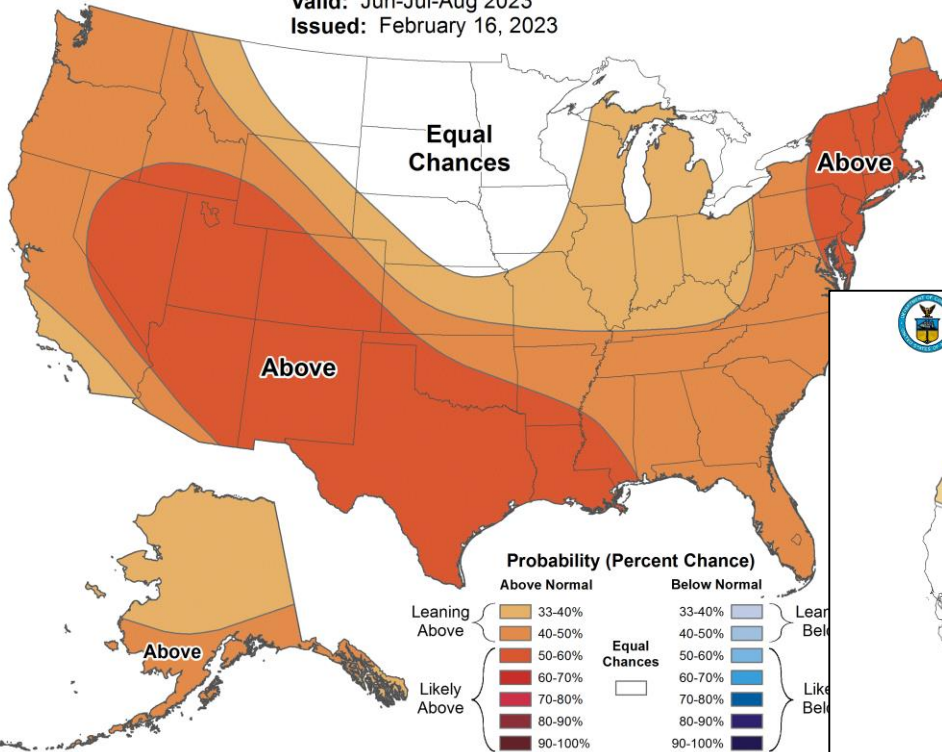


# June - August 2023 Temperature & Precipitation Outlook



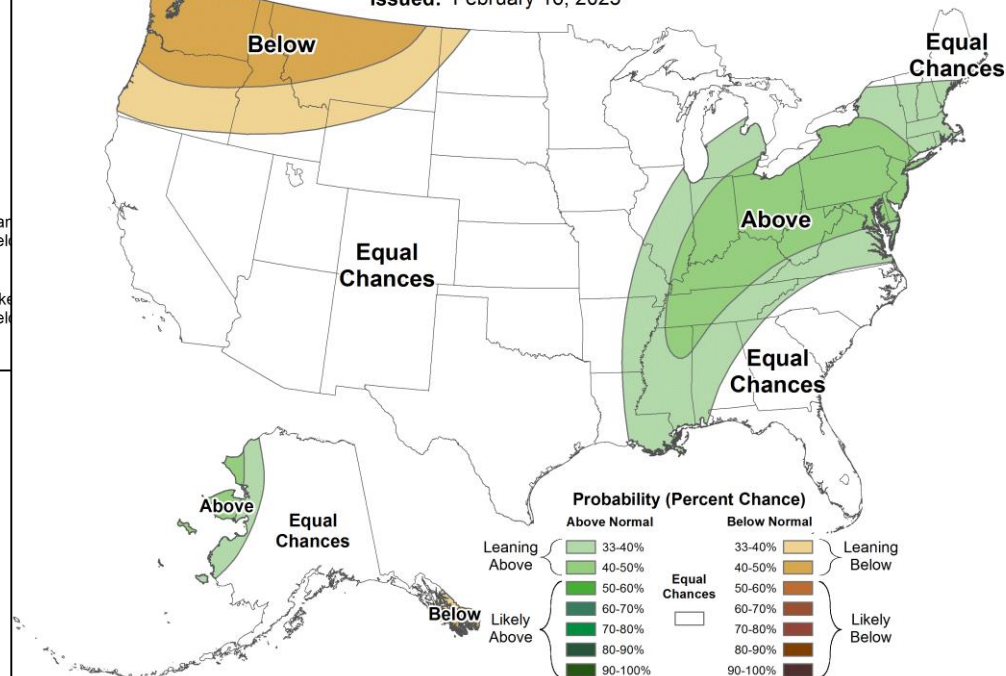
## Seasonal Temperature Outlook

Valid: Jun-Jul-Aug 2023  
Issued: February 16, 2023



## Seasonal Precipitation Outlook

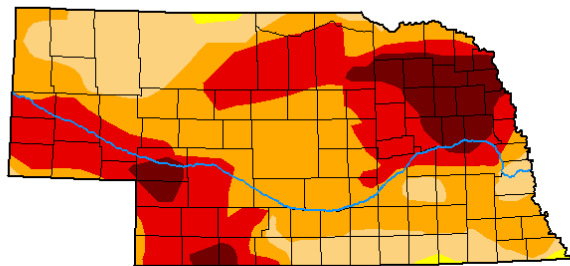
Valid: Jun-Jul-Aug 2023  
Issued: February 16, 2023





# Drought Update

## U.S. Drought Monitor Nebraska



**February 14, 2023**

(Released Thursday, Feb. 16, 2023)  
Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
<b>Current</b>	0.00	100.00	99.21	79.82	40.07	9.97
<b>Last Week</b> 02-07-2023	0.00	100.00	99.71	83.88	45.13	9.97
<b>3 Months Ago</b> 11-15-2022	0.00	100.00	99.78	84.62	58.39	17.37
<b>Start of Calendar Year</b> 01-03-2023	0.00	100.00	99.78	83.95	46.30	12.35
<b>Start of Water Year</b> 09-27-2022	0.00	100.00	94.94	74.27	30.52	10.50
<b>One Year Ago</b> 02-15-2022	0.16	99.84	91.20	14.09	0.00	0.00

Intensity:

- None
- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. For more information on the Drought Monitor, go to <https://droughtmonitor.unl.edu/About.aspx>

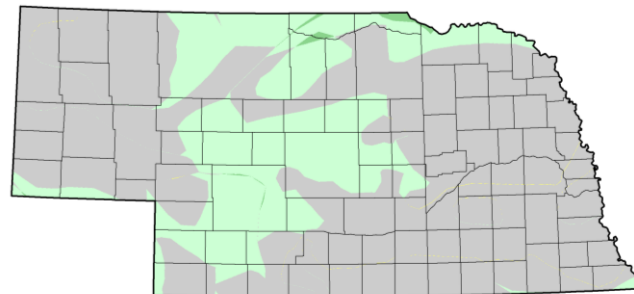
Author:

Brian Fuchs  
National Drought Mitigation Center



[droughtmonitor.unl.edu](https://droughtmonitor.unl.edu)

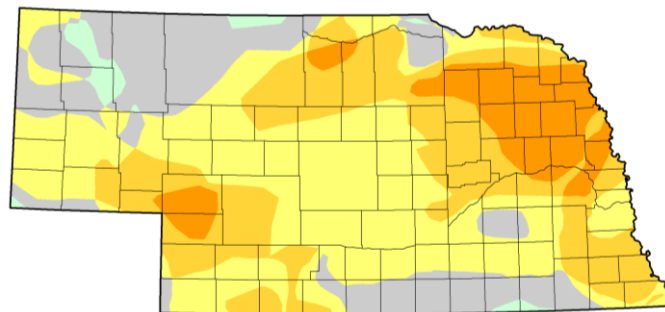
## U.S. Drought Monitor Class Change - Nebraska 8 Week



February 14, 2023  
compared to  
December 20, 2022

[droughtmonitor.unl.edu](https://droughtmonitor.unl.edu)

## U.S. Drought Monitor Class Change - Nebraska 52 Week



February 14, 2023  
compared to  
February 15, 2022

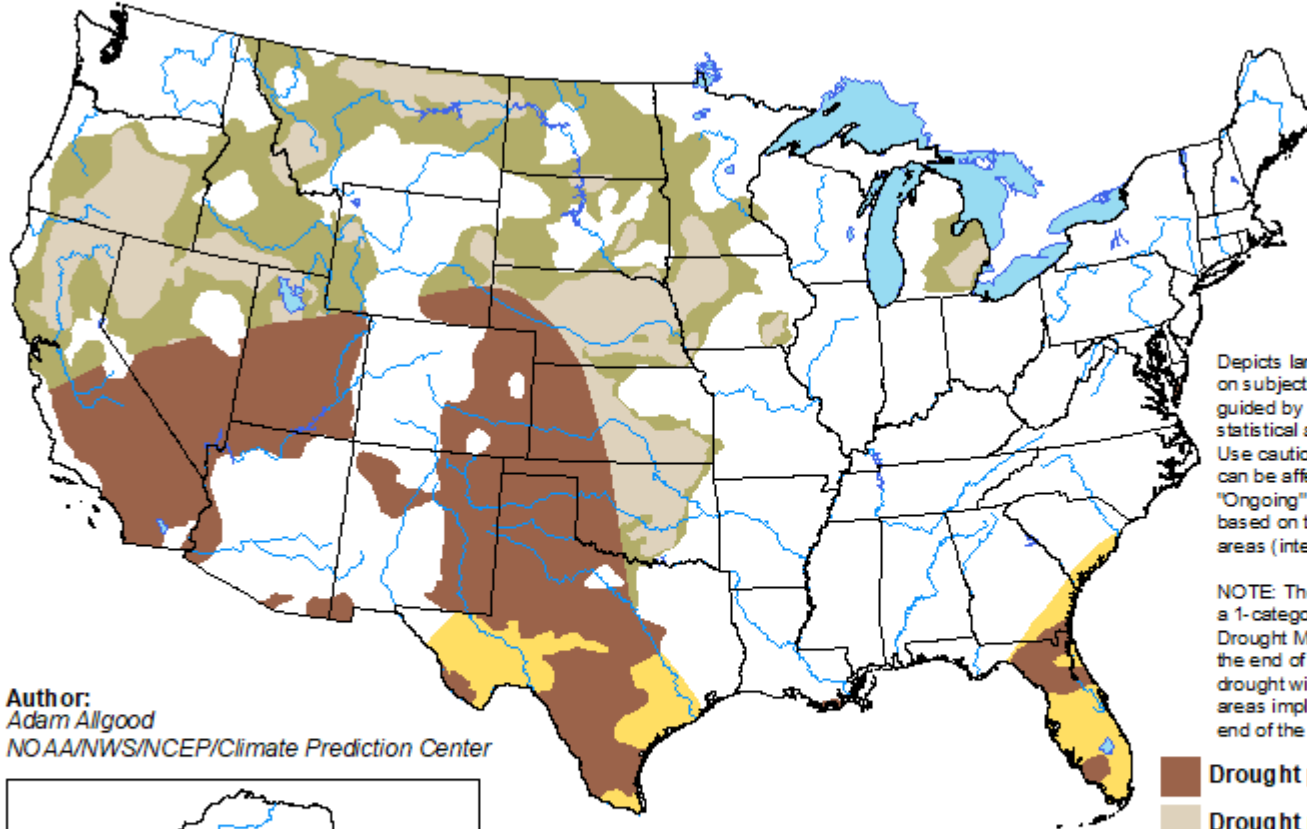
[droughtmonitor.unl.edu](https://droughtmonitor.unl.edu)



# Drought Outlook through May 2023

## U.S. Seasonal Drought Outlook Drought Tendency During the Valid Period

Valid for February 16 - May 31, 2023  
Released February 16

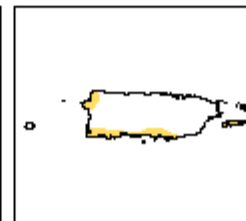
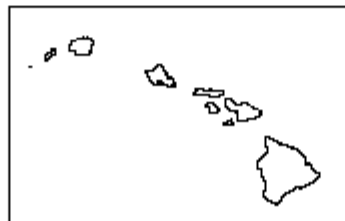
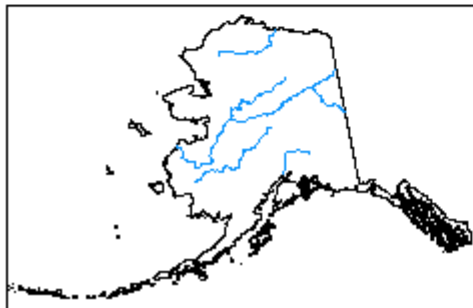


Depicts large-scale trends based on subjectively derived probabilities guided by short- and long-range statistical and dynamical forecasts. Use caution for applications that can be affected by short lived events. "Ongoing" drought areas are based on the U.S. Drought Monitor areas (intensities of D1 to D4).

NOTE: The tan areas imply at least a 1-category improvement in the Drought Monitor intensity levels by the end of the period, although drought will remain. The green areas imply drought removal by the end of the period (D0 or none).

Author:  
Adam Allgood  
NOAA/NWS/NCEP/Climate Prediction Center

- Drought persists
- Drought remains but improves
- Drought removal likely
- Drought development likely



<http://go.usa.gov/3eZ73>



# Key Points

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## \* **Current Conditions**

- \* Current ENSO condition: **La Niña transitioning to Neutral this spring then El Niño?**
- \* Plains snowpack decent so far
- \* Mountain snowpack mainly slightly above average

## \* **Outlook**

- \* Short term (week 2):
  - \* Temperatures near normal
  - \* Precipitation favors above normal
- \* Long term:
  - \* Temperatures mainly equal chances of above/below/normal
  - \* Precipitation mainly equal chances

Next monthly North Central Climate Summary & Outlook Webinar, March 16, 2023

<https://attendeegotowebinar.com/register/98150532442280278>

INSIDE METEOROLOGICAL HQ

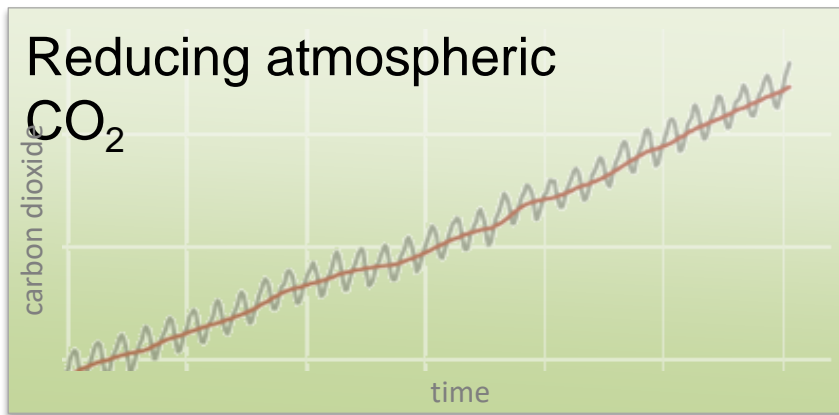


*"I mean, what if we just come out and say that we have no idea what the weather will be?"*

**What Can We Do About It?**

# Mitigation

Reducing greenhouse gas emissions &/or removing carbon dioxide from the atmosphere can lessen the severity of climate change & its impacts.



# Adaptation

Improving our ability to cope with or avoid harmful impacts; or taking advantage of newly favorable conditions. Reducing risk and vulnerability, and exploiting opportunities.





# Mitigation: reducing CO<sub>2</sub> in the atmosphere



- Develop new habits to avoid wasting energy
- Switch to carbon-free energy sources, such as solar & wind
- Plant trees to increase the amount of CO<sub>2</sub> taken up by forests & to reduce severity of 'urban heat islands'
- Establish a carbon tax /dividend to build the cost to pollute into the economy
- Pay ag. for conservation



# Adaptation: Anticipating & adjusting to new conditions

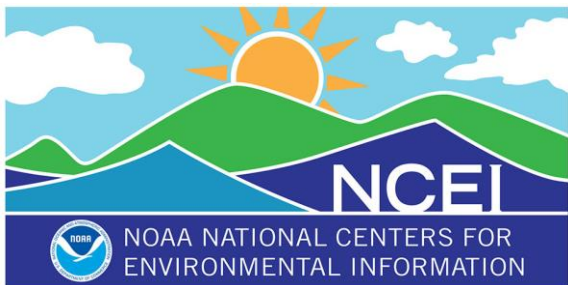
What changes are coming?

What changes do we need to make?

- Install green roofs or reflective roofs
- Develop infrastructure to manage water extremes
- Plant different crops
- Develop new business models
- Make assets & supply chains more resilient



Assessing a region's ability to handle sea level rise and flooding



# Thank You

[Doug.kluck@noaa.gov](mailto:Doug.kluck@noaa.gov)

[www.ncei.noaa.gov](http://www.ncei.noaa.gov)



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